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XX.

THE LATERAL WALL OF THE CAVUM NASI IN MAN, WITH ESPECIAL REFERENCE TO THE VARIOUS DEVELOPMENTAL STAGES.*

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ITHACA.

CONTENTS.

I. Introduction 278
II. The formation of the nasal fossae 279
The nasal anlage 279
The nasal pits 280
The primitive nasal fossae 285
The primitive choanae 286
The nares (epithelial plugs) 286
The primitive palate 287
The definitive palate 287
The permanent choanae and the permanent nasal fossae .. 288
III. The development of the lateral wall of the cavum nasi 292
The formation of conchal anlages 292
Views as to the genesis of primitive nasal folds and furrows 293
The early changes in the meatus nasi medius 296
The early changes in the meatus nasi superior 298
The early changes in the superior and dorsal portion of the nasal fossae 299
The number of ethmoidal conchae and meatuses that are differentiated before birth 300
Ethmoidal nomenclature 303
The nasal meatuses and conchae in late fetal stages 305
The accessory folds (conchae) and furrows 318
IV. The anlages of the sinus paranasales 330
The sinus maxillaris 335
The sinus frontalis 337
The cellulae ethmoidales 340
The sinus sphenoidalis 341
V. Later developmental changes on the lateral nasal wall 342
The number of ethmoidal conchae in the adult 342
The ethmoid cells and their ostia 344
The conchal cells 347
The ostia maxillaria 348
The communication of the frontal sinus with the middle meatus 354
VI. Summary 359
Bibliography 364

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I. Introduction.

A survey of the literature on the lateral wall of the cavum nasi indicates that commendable researches have been carried out by different investigators. Although much careful work has been done, conflicting opinions are held on some points of the development and the gross anatomy of this portion of the olfactory organ. The idea of an unvarying typical form in the gross anatomy of the structures and relations in this region of the nose seems too much in evidence in some of the general text-books of anatomy. In fact the exceptions in some instances to the descriptions given are so numerous that the exception is described rather than the average condition. This is especially true in the manner of communication of the naso-frontal duct with the middle nasal meatus. The ostium maxillare accessorium—a very common aperture indeed—does not receive the recognition it should have. According to my series of specimens, 62.5 per cent of ethmoidal regions possess in the adult three conchæ. Books generally describe and picture two ethmoidal conchæ as the typical number, and apparently would have us think that three ethmoidal conchæ are rather exceptional.

In order to determine whether the embryology would account for the varied adult conditions one meets, I undertook the study of the various developmental stages in the formation of the complex lateral nasal wall. It was deemed essential that the embryologic stages in the formation of the nasal cavity be considered before taking up for detailed study its lateral wall. The paper will, therefore, include: (1) a brief description of the developmental stages of the nasal fossæ; (2) the detailed embryology of the lateral walls of the nasal fossæ; (3) the gross anatomy of the lateral walls as presented in the term fetus and the young child; (4) the adult lateral walls with especial reference to some later developmental changes.

It is obvious that the fundamental structures to be considered in a study of the development of the lateral wall of the cavum nasi are: (1) the nasal meatuses and the nasal conchæ; (2) the accessory furrows and the accessory folds (conchæ); (3) the anlages of the sinus paranasales.

The materials used in this investigation include the following:

a. Human embryos at successive ages from 21 days up to the fetus at term;

b. Fifty lateral nasal walls of new-born children;

c. Twenty lateral nasal walls of children, ranging in age from birth to 15 years;

d. One hundred and fifty adult lateral nasal walls, ranging in age from 15 to 88 years;

e. Embryologic and adult specimens of the lateral nasal wall of the cat, dog, muskrat, woodchuck, skunk, monkey, pig, sheep, and cow.

The lateral wall of the nasal cavity of human embryos, aged respectively 35, 43, 49, 58, 70, 83, 103, 120, 210, and 280 days, was modeled by the blotting-paper method. Some of the models were sectioned at appropriate planes to facilitate a more detailed study of parts. In a number of instances the nasal fossæ were also reconstructed, in order to aid in a better understanding of certain developmental stages. Through the kindness of Mrs. Gage, who had previously modeled a 21-day human embryo, I had the privilege of studying this region at this early stage of development.

The ages of all the human embryos studied were determined by the Mall-method (Catalogue of the collection of human embryos in the anatomical laboratory of the Johns Hopkins University, Baltimore, 1904).

I wish to take this opportunity for expressing grateful acknowledgment to Professors Kerr, Kinsbury, and Tinker for helpful suggestions. I also wish to express my appreciation of the abundant material and other facilities placed at my disposal by the departments of anatomy, and embryology and histology. To Professor and Mrs. Gage, for many courtesies extended during this piece of research, I wish to express thanks.

II. The Formation of the Nasal Fossæ.

The Nasal Anlage.

The nasal anlage apparently establishes itself about the third week of embryonal life as localized thickenings of the ectoderm. Kallius and Mihalkovics place the earliest trace of the nasal anlage at the beginning of the third week, and Bryce at the end of the third week of embryonal life. Mrs. Gage refers to the nasal epithelium in a "three weeks human embryo."

These thickened ectodermal or nasal areas are situated on both sides of the outer surface of the wall of the fore-brain, just superior to the primitive oral fossa. Whether the nasal areas of the human embryo are at first connected, and later undergo division into two distinctly separate halves, is not definitely known. The H-shaped nasal area of Mrs. Gage's 21-day embryo seems significant. She figures two lateral plates connected by an intervening bar of apparently similarly thickened ectoderm. Minot says: "It is possible that more exact observation will show that in all vertebrates there is at first a single plate, which is early divided." Doubtless this will remain a mooted point in man until a sufficient number of human embryos of the proper age fall into the hands of different observers.

Bedford found the thickness of the olfactory areas in swine embryos of 5 mm. length to be 0.075 mm. Kallius found that, while the general ectodermal thickness was 0.01 mm., the thickened nasal areas measured from 0.044 to 0.060 mm.

THE NASAL PITS.

During the fourth week the nasal areas become depressed—according to Mihalkovics at the end of the third week. This depression is not due to an invagination of the nasal areas, but it is passive and is caused by an increase in the thickness of the surrounding mesenchyma. These ridges of thickened mesenchyma around the nasal areas push the ectoderm into relief. In this manner each nasal area becomes surrounded by a fold, and is thus passively depressed. The folds are not complete, but are deficient inferiorly, and the thickening is most marked medially and laterally. The comparatively excessive medial and lateral thickening is thought by Kallius to be in anticipation of the later medial and lateral nasal processes. The nasal plates or areas thus become the olfactory or nasal pits, separated by a broad mass of tissue—the fronto-nasal process or the Stirnfortsatz of German embryologists.

The pits are primitively more or less pyriform in shape. The clubbed ends are directed somewhat medially and towards the vertex of the head, and the inferior extremities are directed somewhat laterally and towards the primitive oral fossa—the stomodæum. As the pits deepen they seem to

separate the inferior portion of the fronto-nasal process on both sides into medial and lateral parts—the anlages of the medial and the lateral nasal processes. During the latter part of the fourth week, or early in the fifth week, the median portion of the fronto-nasal process undergoes further differentiation into a median or unpaired part, and two lateral or paired parts. The latter are globe-like and will be spoken of as the medial nasal processes (Processi globulares, His), and they form the immediate medial boundaries of the nasal pits. At the same time the lateral portions of the fronto-nasal projection grow caudally and form the lateral nasal processes—the immediate lateral boundaries of the nasal pits, or the primitive lateral nasal walls.

Up to this time the nasal pits are not closed in inferiorly, but communicate freely with the primitive oral fossa. In other words, the nasal pits and the oral fossa represent in a sense a common cavity. At this stage of development the maxillary processes of the first or mandibular arches grow ventrally and medially and abut—later fuse—with the medial nasal processes (Processi globulares). This fusion closes in the superior boundary of the primitive oral cleft, and at the same time shuts off the path of communication between the nasal pits and the oral cavity, i. e., the nasal pits are closed in inferiorly (figs. 1 and 3). The coalescence of the maxillary processes with the medial nasal processes forms the primitive inferior boundaries of the nasal pits; subsequently, however, the later extensions of the lateral nasal processes, medially and ventrally above the maxillary processes, meet and fuse with the medial nasal processes, to form the immediate inferior boundaries of the nasal pits (fig. 1). His has also pointed out, in case of arrested development in this region, that at times the lateral and medial nasal processes fuse, but that the maxillary process, on one or both sides, remains short and does not develop sufficiently to fuse with the medial nasal process as it normally does. In such cases the nasal pits are closed in below and are separated from the oral cavity, yet clefts exist between the medial nasal and the maxillary processes.

Fusion also takes place laterally between the maxillary and lateral nasal processes. Along the floor of the now rudimentary naso-optic furrow, a bud-like thickening of the rete

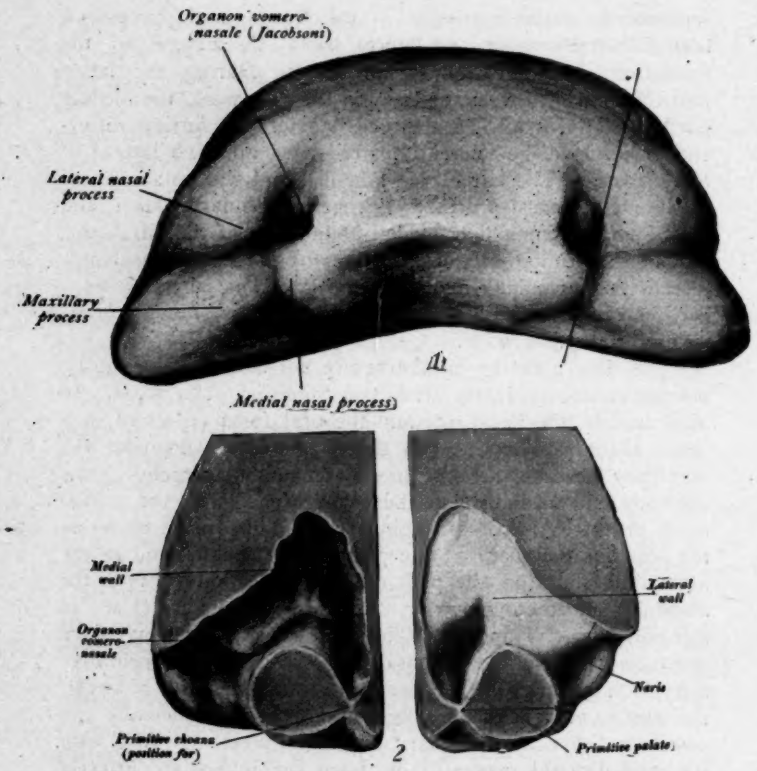


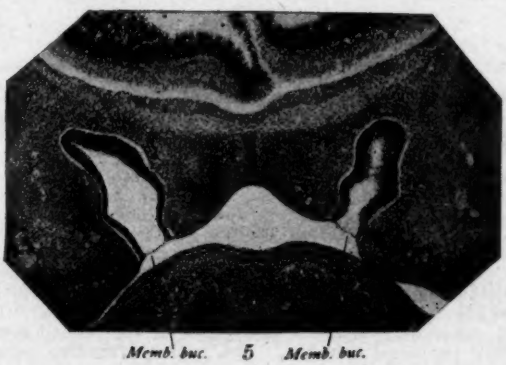
Fig. 1 (× 30) Drawing of a reconstruction of portion of the head of an embryo aged approximately 35 days (Human embryo, No. 6, Cornell University series, slides 50-57 inclusive). The figure represents a caudo-ventral view of the reconstruction.

Note the wide separation of the nasal fossae at this time, and that the fossae do not communicate with the mouth cavity. The maxillary and the medial nasal processes have fused, thus shutting off the nasal pits from the mouth cavity. The lateral nasal processes have not yet fused with the medial nasal processes. The external nose has not yet taken on any definite shape. Note the points for the primitive choanae and the extent of the primitive palate.

Fig. 2 (× 45) Drawing of a reconstruction of the left nasal fossa. The reconstruction is from the same embryo as that in fig. 1, and the plane of section is indicated by the line drawn over the left nasal fossa in fig. 1. Note the very simple lateral nasal wall at this stage of development and compare it with the medial wall. In a short time the lateral wall becomes much more complex and the medial wall relatively less so.

3
Fusion.

Med. nas. proc.
4
Max. proc.


Memb. buc.
5
Memb. buc.

6

EXPLANATION OF FIGURES.

Figs. 3, 4, 5 (33.2) Photomicrographs of frontal sections through the head of an embryo aged approximately 35 days (Human embryo, No. 26, Cornell University series, slides 19 and 20). The sections are in the region of the primitive nasal fossae. Section fig. 3 is the most ventral and section fig. 5 the most dorsal of the three.

Fig. 3. Note that in the region of the coalescence of the medial nasal and the maxillary processes there is no intervening ectoderm. Fusion is complete and absolute, in that the mesenchymal tissue of the maxillary and medial nasal processes is continuous.

Fig. 4. Note the ectodermal strands between the medial nasal and the maxillary processes; the mesenchymal tissue of these processes is not continuous. Compare this condition with fig. 3.

Fig. 5. On both sides the two layers of epithelium, oral and nasal, have become attenuated and thinned out to represent single layers of cells. These are the bucconasal membranes which ultimately rupture to establish the primitive choanae.

Fusion, = coalescence between the maxillary and the medial nasal processes; Med. nas. proc., = medial nasal process; Max. proc., = maxillary process; Memb. buc., = membrana bucconasalis.

Fig. 6 (× 18) Photomicrograph of a frontal section through the ventral portion of the nose of an embryo aged approximately 49 days (Human embryo, No. 28, Cornell University series, slide 40).

Shows the epithelial plugs occluding the nares. This is a rather common condition during the latter part of the second month and throughout the third month. It also occurs after this period, as I have seen it in a 120-day embryo.

mucosum of the epidermis establishes the anlage of the nasolacrimal passages. These passages will again be referred to in connection with their apertures on the lateral nasal walls. The nasolacrimal ducts usually establish communications with the inferior nasal meatuses at about term. This may, however, be longer delayed.

For some time the lines of fusion of the maxillary and the lateral nasal processes with the medial nasal processes are represented by strands of ectodermal tissue. These ectodermal fusion-lines soon disappear ventrally and are replaced by indifferent mesenchyme, i. e., the mesenchymal tissue of the maxillary and the lateral nasal processes becomes continuous with that of the medial nasal processes. Fusion in this manner becomes permanent and absolute (fig. 3). Farther dorsally the ectodermal tissue does not wholly disappear, but strands of the latter tissue remain between the abutting processes. In these positions the primitive choanæ ultimately become established (figs. 2 and 4).

THE PRIMITIVE NASAL FOSSAE.

By this time (35-day embryo) the nasal pits have deepened dorsally, and more or less superiorly and inferiorly. The olfactory organ is now represented by two blind pouches lying in the mesenchymal tissue above the oral cavity. The pits have now developed sufficiently so that they may be termed the primitive nasal fossæ. The fossæ communicate freely with the exterior by means of the nares, but, in the absence of choanæ, they end blindly at their dorsal and inferior terminations (fig. 2). They are rather widely separated at this time (fig. 1). A reference to fig. 2 will show both the lateral and medial walls of the left nasal fossa of a 35-day embryo. It will be noticed that the lateral wall is extremely simple, presenting merely a plane surface. The medial or septal wall is slightly grooved, and the groove overhung by a fold. This is the anlage of the organon vomeronasale (Jacobsoni). Note also that the fossa ends blindly and that there is no connection between the oral and the nasal fossa at this time. The point of the primitive choana (posterior naris) is nearly thinned out sufficiently to represent the membrana bucconasalis (fig. 5).

THE PRIMITIVE CHOANAE.

The dorsal extension of the blind pouches or primitive nasal fossæ continues until the ectoderm of the nasal fossæ meets the ectoderm of the oral fossa. We have now in these positions merely thin membranes composed of two layers of abutting epithelium—nasal and oral—separating the dorsal portions of the primitive nasal fossæ from the oral cavity. These membranes, which have been carefully studied and named by Hochstetter, the "Membranæ bucconasales" (fig. 5), become so attenuated and thinned out that they finally rupture. The membranes may rupture at the same time or each may rupture independently of its mate.

According to the embryos studied for the substance of this paper the bucconasal membranes rupture from the 35th to the 38th day of embryonal life. Sudler found connection between the oral and nasal fossæ in a 5-weeks embryo. Hochstetter found in an embryo of "11 mm. lang bei 9 mm. Kopflänge" that the nasal fossæ ended blindly dorsally, and in an embryo of "15.5 mm. Länge und 10 mm. Kopflänge," the bucconasal membranes were broken through. He, however, found that the membrane was rather excessive on one side, apparently indicating recent rupture. The approximate age of these embryos would be 33 and 39 days, respectively. Kölliker places the time of establishment of the primitive choanæ "in der zweiten Hälfte des zweiten Monates." The apparent discrepancy in the time at which the bucconasal membranes rupture is doubtless due to different methods of determining the age of embryos.

As a result of the rupture of the bucconasal membranes we have established two openings—the primitive choanæ (primitive Gaumenspalten, Dursy; innere Nasengänge, innere Nasenlöcher, Kölliker). There is thus established in man for a second time a communication between the oral and the nasal fossæ. The hitherto blindly ending nasal fossæ now communicate not only with the exterior by means of the nares, but also with the mouth cavity by means of the primitive choanæ.

EPITHELIAL PLUGS IN THE NARES.

When first formed the nares communicate freely with the exterior, but shortly afterwards, say about the fortieth day of

embryonal life, the lumina of the nares in very many cases become filled in with epithelial plugs (figs. 6 and 7). This plugging, which is due to a proliferation of the epithelial cells, seems to take place some time after the fusion of the medial and lateral nasal processes. In some cases the plugging is absolute, and in others deviating passages through the plugs may be seen. Sometimes the plugs are more or less fenestrated. I find plugging rather frequent from the fortieth to the sixtieth day. I have, however, seen it in a 120-day embryo. The passages (nares) are apparently later opened by a shedding of the epithelial plugs rather than by a resorption of the cells—probably both factors are involved. As evidence of a shedding of the epithelial plugs we frequently find shreds of epithelial masses extruding from the nares.

THE PRIMITIVE PALATE.

With the formation of the primitive choanæ we have also established the primitive palate, i. e., the portion of the roof of the oral fossa extending from the primitive choanæ to the nares. This condition is, however, of short duration because the definitive palate soon begins to form, and the lateral walls of the nasal fossæ thus become limited inferiorly. In the formation of the definitive palate the nasal fossæ appropriate a considerable portion of the primitive oral cavity. This is readily understood when we recall the superior boundary of the primitive oral cavity dorsally. Ventrally the mouth cavity is bounded superiorly by the primitive palate, but dorsally the mouth cavity extends into the future nasal cavity until the formation of the definitive palate establishes a roof for the mouth cavity dorsally (figs. 8, 9, 11, 13, 14 and 15).

THE FORMATION OF THE DEFINITIVE PALATE.

A reference to figs. 10, 13, 14 and 15 will indicate the stages in the formation of the definitive palate, and the manner in which the lateral nasal wall becomes limited inferiorly. The first step in the production of the definitive palate is the appearance of the palatal ridges. These are more or less wedge-shaped processes which grow caudally and somewhat medially from the medial sides to the maxillary processes. The palatal processes appear from the forty-fifth to the forty-eighth day

of embryonal life, and at first hang almost vertically towards the mouth cavity, on either side of the tongue (fig. 13). They extend from the line of union between the medial nasal and the maxillary processes, where they are continuous with the primitive palate, dorsally to the wall of the pharynx, where they are continuous with the palato-pharyngeal folds. The palatal processes limit the lateral walls of the cavum nasi inferiorly.

It will be noticed that the tongue is at first between the palatal processes, i. e., the processes extend below the level of the dorsum of the tongue (figs. 10 and 11). Soon the tongue sinks and comes to occupy a lower position in the mouth cavity. With this change of the tongue the palatal processes become rotated from an almost vertical and sagittal plane to a horizontal plane (compare figs. 13 and 14). The processes now shortly meet in the median plane above the tongue, and fuse from before backwards along the opposed edges. In this manner the separation of the nasal fossæ from the mouth cavity is made complete and permanent. However in the ventral portion of the palate, where the palatal processes do not come in contact with each other (due to the interposition of the tissue separating the primitive choanæ) the separation of the nasal cavity from the mouth cavity is not entirely complete. This is brought about by the medial nasal processes uniting and extending dorsally in the roof of the mouth cavity as the intermaxillary process. The latter process projects farthest dorsally in the median plane, and on its lateral borders it is met by the ventral ends of the palatal processes. At these contact points the incisive canals are formed, and the latter at times serve as a means of permanent communication between the oral and nasal cavities. The lumina of the incisive canals are, however, generally obliterated early in life.

THE PERMANENT CHOANAE AND THE PERMANENT NASAL FOSSAE.

Coincidently with these changes in the formation of the nasal fossæ, the primitive choanæ elongate and ultimately occupy their definitive position, and thus become the permanent or secondary choanæ. The changes in the formation of the permanent choanæ also aid materially in increasing the ventro-

EXPLANATION OF FIGURES.

Figs. 7 to 12 (× 10.5) Photomicrographs of frontal sections of the head of an embryo aged about 43 days (Human embryo, No. 3, Cornell University series, sections 406, 380, 365, 360, 350, 325).

Note the plugging of the nares in fig. 7, and that the conchal anlages have no cartilage in them at this age (figs. 8-11). The mesenchymal tissue is, however, already undergoing condensation in anticipation of cartilage in the regions of the nasal septum and the lateral nasal walls. Compare this condition or pre-cartilage stage with figs. 16 to 20, and with figs. 32 to 38. Note the relation of the tongue to the palatal processes in figs. 8 to 12.

The section shown in fig. 7 is the farthest ventral and that shown in fig. 12 the farthest dorsal in the series.

P. pal., = processus palatinus; Eth. fold, = ethmoidal fold; Max. fold, = maxillary fold.

Fig. 13 (16.6) Drawing of a reconstruction of the lateral wall of the nasal cavity of an embryo aged approximately 43 days (Human embryo, No. 3, Cornell University series, sections 300-420 inclusive).

Shows the vertical position of the palatal process at this time. The definitive palate is not yet formed. Note also the primitive concha inferior (Max. fold) and that it occupies the greater portion of the lateral wall at this early stage. The primitive ethmoidal fold (Eth. fold)—the anlage of the ethmoidal conchae—is very rudimentary at this time.

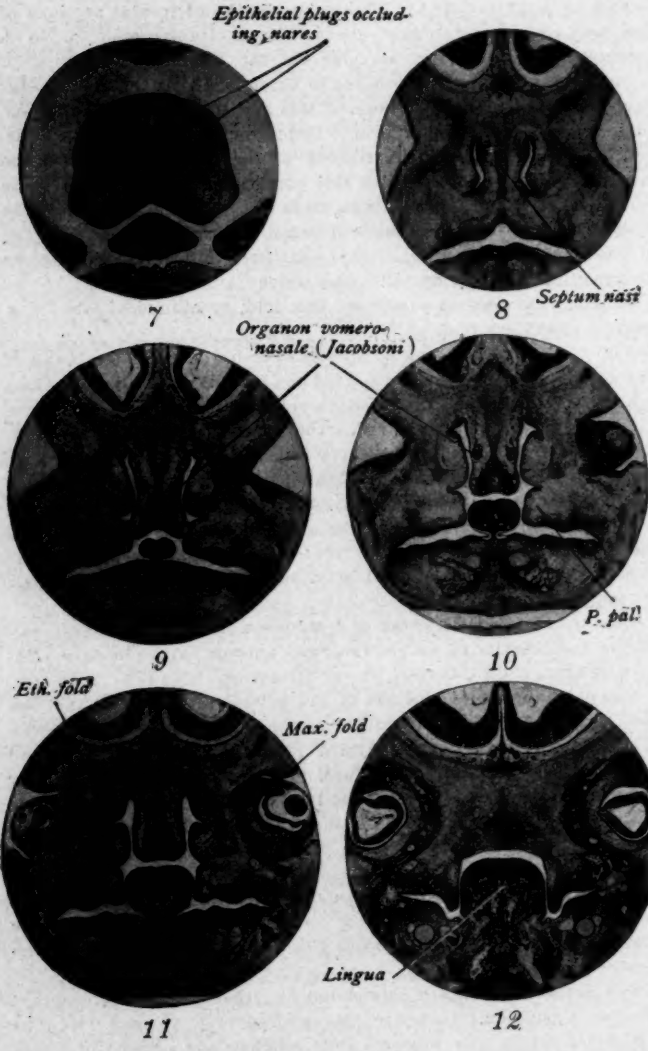
Eth. fold, = ethmoidal fold; Max. fold, = maxillary fold; P. pal., = palatal process.

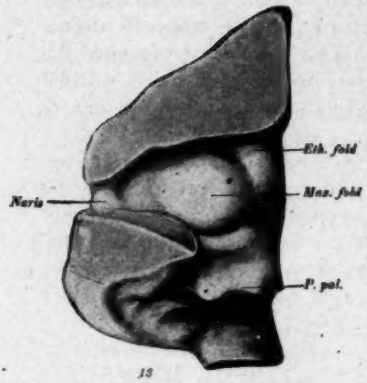
Fig. 14 (× 16.6) Drawing of a reconstruction of the lateral wall of the nasal cavity of an embryo aged approximately 49 days (Human embryo, No. 28, Cornell University series, slides 40-51 inclusive).

Compare horizontal position of the palatal process with the process in fig. 13. The ethmoidal region now has two folds well marked, and a rudimentary third presents in the superior and dorsal portion of the lateral wall. The concha nasalis inferior occupies comparatively less of the lateral wall. Ventrally it will be noticed that the reconstruction does not include all of the lateral wall. The ventral portion of the primitive palate is, therefore, not represented in the reconstruction.

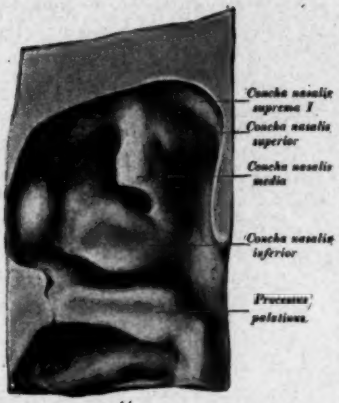
Fig. 15 (× 6.6) Drawing of a reconstruction of portion of the right wall of the nasal cavity of an embryo aged about 105 days (Human embryo, No. 43, Cornell University series, slides 1-90 inclusive).

The definitive palate is completed and the choana has assumed the adult position. Compare this with figs. 2, 13, and 14. The ethmoidal region now presents four conchae, the highest of which is not yet well differentiated. Note the marked lobule in the region of the knee of the concha nasalis media.

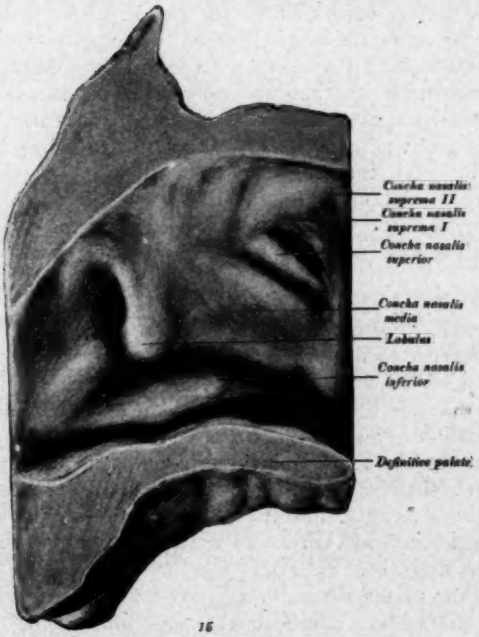

Epithelial plugs occluding nares
Septum nasi
Organon vomero-nasale (Jacobsoni)
P. pal.
Eth. fold
Max. fold
Lingua
7
8
9
10
11
12


Eth. fold
Nasio
Max. fold
P. pal.

13


Concha nasalis suprema I
Concha nasalis superior
Concha nasalis media
Concha nasalis inferior
Processus palatinus

14


Concha nasalis suprema II
Concha nasalis suprema I
Concha nasalis superior
Concha nasalis media
Lobulus
Concha nasalis inferior
Definitive palate

15

dorsal extent of the nasal cavity. The latter now begins to take on its adult form. The nasal septum which already has separated the nasal fossæ ventrally, rapidly fuses with the palate in the median plane, i. e., along the line of fusion of the palatal processes. In this manner the cavum nasi is divided into the nasal fossæ. This division takes place from before backwards.

Before the first appearance of the palatal processes as inferior boundaries of the nasal fossæ, the lateral walls of the fossæ have begun in a simple manner to form the complex configuration which characterizes the adult lateral nasal walls.

III. The Development of the Lateral Wall of the Cavum Nasi.

In the preceding paragraphs we considered the successive stages in the establishment of the nasal cavity, from the thickening of the ectoderm to form the nasal anlage, to the formation of the nasal fossæ. We noted the extreme simplicity of the lateral wall of the nasal cavity during the early stages of development. With these considerations on the various developmental stages of the nasal fossæ and the early condition of the lateral wall as a basis, we may now to better advantage follow in detail the stages in the formation of the various structures found on the lateral wall. We will, therefore, pass, in order, from the very simple lateral wall of the early embryo to the complexly configured wall of the term fetus.

THE FORMATION OF CONCHAL ANLAGES.

A reference to fig. 2 will indicate the extremely simple lateral wall of the nasal fossa of a 35-day embryo. It will be noticed that there is no evidence of the later complexity and configuration caused by the nasal conchæ, the nasal meatuses, the accessory conchæ and furrows, and the anlages of the paranasal chambers. In fact, the medial or septal wall is more complicated at this time than is the lateral wall—this standing in marked contrast to later conditions (compare figs. 2, 13, 14, and 21).

Some days later (38 to 40-day embryo) the inferior portion of the lateral wall immediately superior to the primitive palatal processes begins to bulge towards the lumen of the

nasal fossa. In fact, this bulging for a brief time occupies nearly the whole of the vertical portion of the wall, and approximately the dorsal two-thirds. This fold represents the anlage of the concha nasalis inferior (maxilloturbinal) (fig. 13). Shortly after this (40 to 43 days) a second fold appears superior and somewhat dorsal to the first one. The former (ethmoidal fold) is placed in the superior and dorsal angle of the lateral wall. It seems also to extend up on the nasal septum at this point, and some of its prominence is really due to septal tissue. This fold is the anlage of the conchæ nasales ethmoidales, and in position and relations represents the concha nasalis media (Ethmoturbinale I, Peter; zweite Hauptmuschel, Killian; untere Siebbeinmuschel, Zuckerkandl; Basoturbinale, Schönemann). The fold of the agger nasi (nasoturbinal) can hardly be said to be in evidence at this early stage. It appears later, ventral and superior to the concha nasalis inferior, and ventral to the concha nasalis media.

VIEWS AS TO THE GENESIS OF THE PRIMITIVE NASAL FOLDS AND FURROWS.

From the above we gather that the lateral nasal wall is early thrown into ridges or folds, which are bordered by furrows or depressions. Just how these primitive folds (primitive conchæ) and furrows (primitive meatuses) of the lateral wall are formed is interpreted differently by various writers. While at first thought the views held seem widely divergent, they appear less so after we carefully analyze them. Some of the theories entertained are, however, without foundation.

It was at one time held by some observers that the folds were due to cartilaginous strands pushing the lateral nasal wall medially in the positions of the folds. This theory is, however, not tenable because the folds (primitive conchæ) are invariably present some time before cartilage is found in them. Only later does some of the indifferent mesenchyma contained in the folds change into cartilage; therefore it can have no connection whatever with the establishment of the primitive folds (conchæ).

Legal and Schönemann think that the folds are elevations left by excavations of furrows on the lateral nasal wall. Legal

in offering this explanation especially referred to the inferior nasal concha. Later Schönemann concludes "das nicht die Legalsche Angabe über die Bildung der unteren Muschel völlig zu Recht besteht, sondern dass auch für die sämtlichen anderen Muscheln ein ähnlicher Bildungsmodus angenommen werden muss."

Mihalkovics, according to Schönemann, holds that the folds are at first "frei vorwachsende Duplikaturen der Schleimhaut." Glas, who investigated this field in rats, comes to the following conclusion: "Der Bildungsmodus der Muscheln ist die Resultierende zweier Komponenten: (1) des Auswachsens in die Wandpartien einwachsender Epithelleisten (Fissuren), (2) des Vorwachsens bestimmter Wandpartien."

After a study of these early conditions I am led to believe that the first change in the lateral nasal wall from a more or less even surface (fig. 2) is the production of very shallow grooves; the latter appearing inferior and superior to the position of the primitive concha inferior. These shallow grooves at once throw into slight relief the greater portion of the lateral nasal wall—the anlage of the concha nasalis inferior (maxilloturbinal). I believe that the mesenchymal tissue contained within this primitive fold almost simultaneously undergoes proliferation, thus aiding in early making the fold more prominent. The mucous membrane over the fold may also become thickened, but according to my observations this thickening for the primitive concha inferior is slight. I cannot agree that the formation of a well marked maxillary fold or primitive concha nasalis inferior is wholly due to the formation and deepening of the bordering furrows, but, as stated before, I believe that the formation of very shallow grooves is the primitive step in conchal formation. The proliferation of the mesenchyma (probably also the mucous membrane to some extent) aids materially in causing the primitive concha inferior to bulge into the lumen of the nasal fossa, and the bordering furrows to become passively deeper (figs. 10 and 11).

The ethmoidal fold appears next in the extreme dorsal and superior portion of the nasal fossa, in the angle formed by the lateral wall and the nasal septum in this position (figs. 11 and 13). Since the primitive concha inferior (maxillary fold) takes up the greater portion of the lateral wall at this time

there is little room for the primitive ethmoidal fold (fig. 13). For this reason the latter fold arises in part from the septum. Later the nasal fossa increases in the dorsosuperior direction, and with this the primitive ethmoidal fold passively migrates from the septum. The mucous membrane over the ethmoidal fold is as a rule thickened, and this thickening causes the

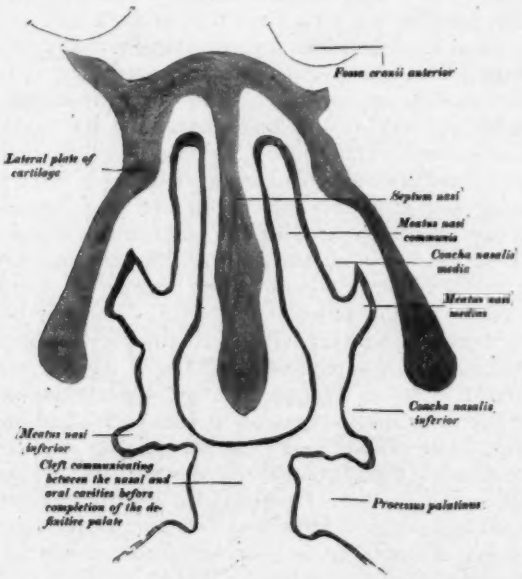

Fossa cranii anterior
Lateral plate of cartilage
Septum nasi
Meatus nasi communis
Concha nasalis media
Meatus nasi medius
Concha nasalis inferior
Meatus nasi inferior
Cleft communicating between the nasal and oral cavities before completion of the definitive palate
Processus palatinus

Fig. 16 (× 26.6) Outline drawing of a frontal section of the nasal cavity of an embryo aged approximately 49 days (Human embryo, No. 28, Cornell University series, slide 48). The nasal and oral cavities are in communication with each other at this point, i. e., the palatal processes have not as yet coalesced in the median plane in the formation of the definitive palate. Note also the simple lateral wall of the middle nasal meatus—compare with fig. 18.

primitive fold to show up well in frontal sections (fig. 11). This, however, does not detract from the statement that the groove between the ethmoidal and maxillary folds is present, at least to some extent, before the folds have gained any appreciable bulging. Later we have a proliferation of the mesenchyma and a deepening of the furrow (primitive meatus nasi medius) inferior to it, hence the ethmoidal fold becomes

more prominent. Gradually in place of the single ethmoidal fold we have, with the increase of the nasal fossa in the dorso-superior direction, the establishment of anlages of the individual ethmoidal conchæ—this, as a rule, taking place in order from the most caudal to the most cephalic ethmoidal concha (figs. 13, 14, 15, and 21).

As may be inferred from the above, the ethmoidal region on each side presents but for a brief time a single fold (fig. 13). As the nasal fossa enlarges superiorly and dorsally there is a differentiation in this region into two folds (fig. 14)—this change occurring approximately from the forty-eighth to the fiftieth day of fetal life. A later stage, 95 to 100 days, shows three well-formed ethmoidal conchæ (fig. 15). By the fourth month of fetal life the conchal field shows from three to four ethmoidal conchæ, besides the concha inferior. Fetuses from the seventh month to term will, if carefully examined, show from three to five ethmoidal conchæ (figs 21 and 30). Of course in each case a corresponding number of furrows or meatuses are established—some of the meatuses, however, being very rudimentary. After birth the ethmoidal conchæ and meatuses become reduced in number. This reduction is not carried so far in some cases as in others—thus accounting for the supernumerary or additional conchæ and meatuses of many adult noses. Doubtless the number of ethmoidal conchæ that are differentiated before birth have an important bearing on the number of conchæ that may be present in an individual case—this is probably just as important a factor in determining the number of adult ethmoidal conchæ as is the retrogressive change of reduction.

THE EARLY CHANGES IN THE MEATUS NASI MEDIUS.

Thus far only the superficial aspects of the lateral nasal wall, with especial reference to the development of folds and furrows (conchæ and meatuses), have been considered. The general plan of these conchæ and meatuses will be considered in detail in subsequent paragraphs. If now we return to a 40- to 50-day embryo and examine the portion of the middle meatus operculated by the middle nasal concha, we will notice that the lateral wall of this meatus is perfectly even (fig. 16). This study is best made by an examination of serial frontal sections through this region of the nose. This same region

in an embryo aged from 58 to 60 days will indicate the beginning formation of the complicated nature of the meatus nasi medius—the most complex of all the meatuses. This change in the middle meatus is heralded by the appearance of a somewhat crescentic-shaped fold of mesenchyme and mucous membrane, set off by a slightly earlier grooving immediately

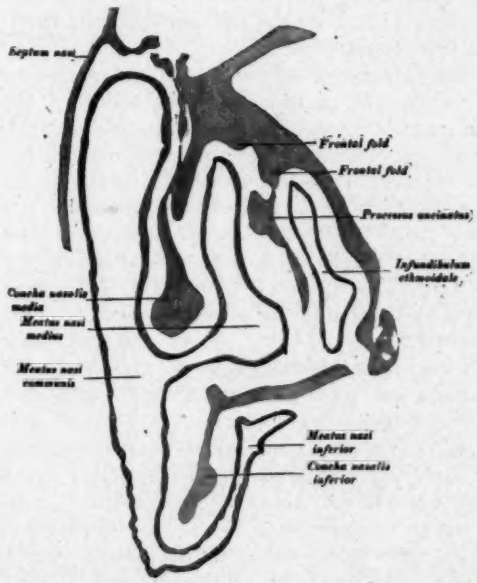


Fig. 17 (× 10) Outline drawing of a frontal section through the nose of an embryo aged 120 days (Human embryo, No. 42, Cornell University series, slide 29).

At this plane of section the processus uncinatus is fused with a frontal fold, and the infundibulum ethmoidale ends blindly. Compare this figure with fig. 18. In the latter figure the plane of section is farther dorsal.

superior to the fold. The latter has its free and rather sharp border directed superiorly and dorsally, and is the anlage of the processus uncinatus. The furrow immediately superior to the fold is the primitive infundibulum ethmoidale (fig. 18). It will be noticed that the furrow communicates rather freely with the meatus nasi medius through a rather widely open cleft—the hiatus semilunaris.

If now we examine a frontal section of a somewhat later embryo we will notice that the infundibulum ethmoidale early tends to develop beyond its primitive limits, and to pouch towards the ventral and superior portion of the meatus nasi medius, here ending blindly. This early, blind, ventral and superior extension of the infundibulum ethmoidale has been erroneously considered by some writers as the primitive sinus maxillaris (fig. 32). Of the bulla ethmoidalis there is nothing to be seen at this time.

About the seventieth day there is a slight, sometimes a comparatively extensive, pouching or evagination of the mucous membrane from the depth of the infundibulum ethmoidale—thus establishing the anlage of the sinus maxillaris. Shortly after this we have the first evidences of the bulla ethmoidalis appearing superior and lateral to the processus uncinatus—this in the form of very low accessory folds or conchæ. By the beginning of the fourth month of fetal life the folds of the bulla are fairly well formed. At the end of the fourth month the folds with the bordering accessory furrows are in many cases well outlined (fig. 18). From some of the accessory furrows the so-called middle group of ethmoidal cells develop, and in a sense the former are the anlages of the latter structures. At a comparatively early stage we have evidences of a beginning extension of the middle meatus in a ventral and superior direction. This is the anlage of the recess, which Killian in later fetuses terms the "Recessus frontalis" and it is in reality the first step in the formation of the sinus frontalis and the most ventral of the anterior group of ethmoidal cells. The accessory folds and furrows, and the frontal recess of the middle meatus will be considered in detail in a subsequent portion of this paper.

THE EARLY CHANGES IN THE MEATUS NASI SUPERIOR.

With the appearance of the accessory folds (conchæ) and the frontal recess of the middle meatus, we have the establishment, in very many cases, of the anlage of an accessory fold (concha) on the lateral wall of the superior meatus. This fold early tends to form very shallow recesses superior and inferior to it, and occasionally it has been mistaken for the superior nasal concha (fig. 19). From the superior and inferior recesses, and from the ventral and superior extremity

of the superior meatus, most of the posterior group of ethmoidal cells develop—a matter which will be taken up subsequently. Frequently a posterior ethmoid cell develops from the meatus nasi suprema I. The latter meatus, however, is present in only 62.5 per cent of my adult specimens.

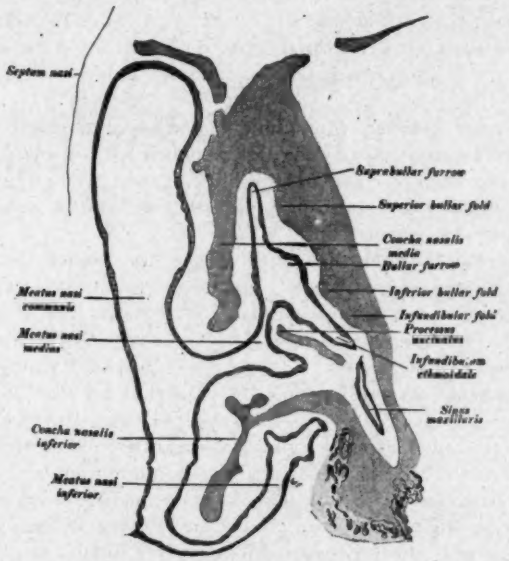


Fig. 18 (× 10) Outline drawing of a frontal section through the nose of the same embryo as that in fig. 17. The plane of section in this figure (slide 40) is farther dorsal, and is in the region of the bullar folds.

The processus uncinatus projects free at this plane of section, and the infundibulum ethmoidale communicates rather freely with the meatus nasi medius. The cartilage of the processus uncinatus is not continuous with the cartilage of the lateral plate at this level—compare this with the cartilage of the processus uncinatus in fig. 17.

THE EARLY CHANGES IN THE SUPERIOR AND DORSAL PORTION OF THE NASAL FOSSAE.

A frontal section through the dorsal portion of the nasal cavity in a three-months embryo will already indicate the manner of constriction of a portion of the dorsal and superior

part of the nasal fossæ in the formation of the early anlages of the sinus sphenoidales. In a 120-day embryo the sphenoidal sinus anlages are well advanced, but have not reached, or at least not extended into, the body of the developing sphenoid bone. The lateral nasal plates of cartilage more or less overhang the sphenoidal-sinus anlages (fig. 20).

THE NUMBER OF ETHMOIDAL CONCHAE AND MEATUSES THAT ARE DIFFERENTIATED BEFORE BIRTH.

As to the number of ethmoidal conchæ and meatuses that are differentiated during the latter months of intrauterine life conflicting opinions are held. The meatus inferior and the concha inferior are constant, hence they will not be considered in the present connection.

Zuckerkandl states that three and at the highest four ethmoidal meatuses are formed (including the meatus medius). This would indicate three and at the highest four ethmoidal conchæ. In reference to the latter he says: "Drei Siebbeinmuscheln repräsentieren . . . die typische Faltungsweise des Siebbeines." Killian, whose researches on this point are extensive, states that in fetuses of the ninth to the tenth month, five and even six ethmoidal meatuses (Hauptfurchen) are present. He also finds a corresponding number of ethmoidal conchæ (Hauptmuscheln), but includes among the number, as his "erste Hauptmuschel," the agger nasi (nasoturbinal) plus the processus uncinatus. Killian comes to the following conclusion: "Mit dem, was das aufmerksame Studium meiner Prepärate ergiebt, stimmen die Beobachtungen an meiner ganzen Material überein, wobei ich bemerke, dass die erste, zweite und dritte Hauptfurchen fast regelmässig vorkommen und dass die vierte in über 30 Fällen, die fünfte und sechste in noch einigen weiteren Beispielen vertreten sind." Kallius holds that seldom are all six furrows differentiated. Mihalkovics says that "Knorpelige Muscheln sind beim Menschen im embryonalen Leben stets 4 vorhanden, oft auch 5." The latter, however, includes among this number the concha nasalis inferior, which has not been done by the other writers mentioned, since they considered the ethmoidal region only.

After an extended study of the ethmoidal region in fetuses,

I find that there is more or less uniformity up to the fourth month. However, during the latter half of fetal life there is indeed great variation in the number and form of the ethmoidal conchæ and meatuses. Notwithstanding this I think that careful analyses indicate a general plan more or less common to most ethmoidal regions—some specimens differing here and others there from the plan. Occasionally some specimens

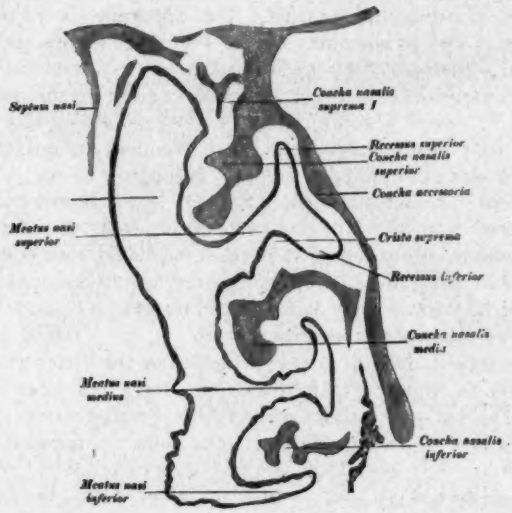


Fig. 19 (× 10) Outline drawing of a frontal section through the nose of the same embryo as those in figs. 17 and 18. This section (slide 67) is in the region of the accessory concha of the meatus nasi superior, hence is farther dorsal than that in fig. 17.

Shows how the crista suprema of the concha media aids in forming the recessus inferior of the meatus superior. Compare the meatus superior of this section with the meatus medius of section, fig. 18.

differ so markedly from this general plan that they are difficult of comparison.

Doubtless the personal equation is quite a factor in determining the number of ethmoidal conchæ. In many cases some of the conchæ are so rudimentary that one observer might not consider the under-developed folds as individual

conchæ, yet another observer would include them among the number.

I find by careful study of the ethmoidal region in a series of specimens from late fetuses that five ethmoidal conchæ are not uncommon; however, the most superior and dorsal conchæ may be but faintly outlined. We occasionally find all five conchæ well marked (fig. 21). In this respect my observations agree with those of Killian—he giving six as his highest number of ethmoidal conchæ. The apparent discrepancy in number is due to the fact that he (Killian) names the agger nasi (nasoturbinal) plus the processus uncinatus as his "erste Hauptmuschel." On the other hand, I do not do this, but consider his "zweite Hauptmuschel" as my concha nasalis media. I find four ethmoidal conchæ very frequent indeed, in fact, fully 65 per cent of later fetuses, according to my series of specimens, present four (fig. 26). It must, however, be remembered that some of the conchæ or folds are extremely rudimentary, nevertheless they must be taken into consideration when analyzing the ethmoidal region. Occasionally some specimens show a low degree of differentiation and possess but three ethmoidal conchæ (fig. 28).

It is indeed difficult to say whether in the latter cases the progressive changes (differentiation) have not been carried so far as in some others, or whether retrogressive changes (coalescence of two or more conchæ with obliteration of the intervening furrows) took place at an earlier time. The latter is doubtless an active process after birth, because we rarely find more than three ethmoidal conchæ in the adult. It is, therefore, quite possible that retrogressive changes are instituted much earlier in some cases, and that the ethmoidal regions which have a comparatively small number of conchæ in the late fetus, originally possessed a larger number of folds. I, however, believe that in the majority of these cases the differentiation in the ethmoidal region is not carried so far as in some others, hence a smaller number of ethmoidal conchæ.

Whatever the number of ethmoidal conchæ may be, there is a corresponding number of meatuses or furrows; i. e., each concha more or less overhangs a furrow or meatus. This overhanging is especially marked in the meatus nasi medius. Killian gives six as his highest number of "Hauptfurchen"—this would place a meatus dorsal and superior to the most

cephalic concha present. I, however, prefer to think of this region as belonging to the recessus sphenoethmoidalis. The latter because it corresponds to the position of the adult recessus sphenoethmoidalis; also that after birth we do not usually think of the meatus nasi as being superior to, but inferior to the corresponding conchæ nasales. The recessus sphenoethmoidalis, however, is very closely related to the meatus nasi suprema I, and in the absence of the latter with the meatus nasi superior.

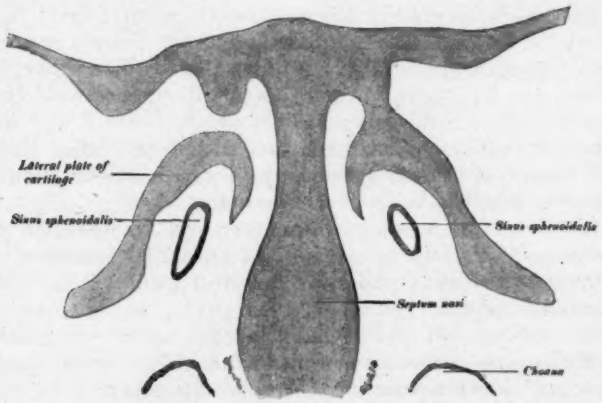


Fig. 20 (× 10) Outline drawing of a frontal section through the dorsal portion of the nasal cavity. The section (slide 91) is from the same embryo as are those represented in figs. 17, 18, 19. Note how the dorsal and superior portions of the nasal fossae establish the anlages of the sinus sphenoidales.

ETHMOIDAL NOMENCLATURE.

Owing to the comparatively large number of ethmoidal conchæ and meatuses present in the nose of the late fetus in comparison to adult conditions, it will be necessary for the sake of description to adopt some nomenclature sufficiently extensive to cover the extreme cases one meets at this time.

Zuckerkandl's nomenclature is not extensive enough to cover the fetal field in all cases. He designates the ethmoidal conchæ as "untere, mittlere, obere, und vierte (oberste) Siebbeinmuscheln." He speaks of the ethmoidal meatuses as "in-

ferior, superior, und suprema Fissuræ ethmoidales." He, however, complicates his nomenclature by his views on the "vierte (oberste) Siebbeinmuschel." He makes the following statements:

"In 6.7 Percent der Fälle tritt bei Kindern und Embryonen noch eine vierte Siebbeinmuschel auf, die sich zwischen die mittlere und obere Concha ethmoidalis einschiebt. . . Vierte Siebbeinmuschel (Concha suprema), begrenzt: unten von der Fissura ethmoidalis suprema, oben von der Siebplatte."

There is doubtless a discrepancy in the above statements. If the "vierte (oberste) Siebbeinmuschel" inserts itself ("einschiebt") between the "mittlere und obere Concha ethmoidalis," then the furrows or meatuses that border it are his (Zuckerkandl's) "superior und suprema Fissuræ ethmoidales," and the "obere Siebbeinmuschel" would be between his "Fissura ethmoidalis suprema" and the "Siebplatte." The reader will at once notice the difficulty encountered in attempting to compare this with other nomenclatures.

Killian adopts a nomenclature to cover, according to my specimens, all cases, by naming the ethmoidal meatuses, including the meatus medius, "Hauptfurchen 1-6;" and the ethmoidal conchæ, "Hauptmuscheln 1-6." He, however, includes among his "Hauptmuscheln" the agger nasi (nasoturbinal) plus the processus uncinatus as his "erste Hauptmuschel," which has not been done in this paper.

Peter also covers the field by designating the ethmoidal conchæ "Ethmoturbinalia 1-5." The latter does not include Killian's "erste Hauptmuschel" among this number.

Schönemann speaks of the concha media as the "Basoturbinale," and Paulli in an exhaustive study refers to all the major nasal conchæ as "Endoturbinalien," in contradistinction to the accessory conchæ, which he designates as "Ektoturbinalien."

The general text-books of anatomy, also the BNA (nomina anatomica, Basel), offer nomenclatures sufficient for practically all adult conditions, but not for the late fetal stage. In order not to depart too far from the general texts on anatomy and the BNA, yet offer for late fetal conditions a sufficiently comprehensive nomenclature, I will in subsequent paragraphs use the following names for the several nasal conchæ and meatuses.

The nomenclature offered is not necessary for all cases, nevertheless it is essential to have a terminology that covers not only the adult, but also the extreme fetal conditions one frequently meets.

Nomenclature used in this paper:

Meatus nasi.	Conchæ nasales.
Meatus nasi inferior,	Concha nasalis inferior,
Meatus nasi medius,	Concha nasalis media,
Meatus nasi superior,	Concha nasalis superior,
Meatus nasi suprema I,	Concha nasalis suprema I,
Meatus nasi suprema II,	Concha nasalis suprema II,
Meatus nasi suprema III.	Concha nasalis suprema III.

THE NASAL MEATUSES AND CONCHAE AS SEEN DURING THE LATTER STAGES OF INTRAUTERINE LIFE.

The nasal meatuses and conchæ of the fetus of the latter half of intrauterine life may now be considered in detail. The ethmoidal region is rather complex in construction, and with the accessory folds (conchæ) and furrows, the anlages of the paranasal chambers, and the conchæ and meatuses, offers an interesting field for study from the second month on to term. The meatuses will be taken up first for detailed study, followed by the nasal conchæ. After this the accessory folds (conchae) and the accessory furrows of the meatuses will be considered; finally the anlages of the paranasal chambers.

THE NASAL MEATUSES.

The meatus nasi inferior. The meatus nasi inferior is one of the first meatuses to become well established. It is primitively formed between the anlage of the concha inferior and the primitive processus palatinus. Later, with the fusion of the two palatal processes in the median plane to form the definitive palate, the meatus inferior comes to occupy the position between the concha inferior and the floor of the nasal fossa. The ductus nasolacrimalis connects with the meatus inferior approximately at term. A reference to fig. 37 will, however, show a frontal section of the left nasal fossa of a term fetus in which the barrier between the meatus inferior and the ductus nasolacrimalis is still intact, i. e., the duct has not acquired a lumen in the region of the meatus inferior. Finally there are two layers of abutting epithelium, one nasal

and the other that of the duct, forming the barrier. The membrane now seems to thin out and to become attenuated, ultimately rupturing; in other words the duct becomes patent at this point. This attenuation of two layers of abutting epithelium, ultimately resulting in rupture, in order that communication between two cavities may be established, reminds one somewhat of the attenuation and rupture of the membrana bucconasalis.

The meatus nasi inferior is otherwise simple and offers no conditions that warrant a further consideration at this time.

The meatus nasi medius, superior, suprema I, suprema II, suprema III. The ethmoidal meatuses, including the meatus medius—since they have many things in common—may for the time be considered together. It must be recalled that in many cases the meatus suprema I, II, and III are extremely rudimentary and are merely very shallow, short grooves. Again in many instances the meatus nasi suprema II and III are not at all differentiated. The meatus nasi suprema I is the most constant of the supreme meatuses. While we must follow some general type for the sake of description, it does not necessarily indicate that all specimens agree in their entirety.

The ethmoidal meatuses all converge at their inferior and dorsal extremities in the region of the angle formed by the junction of the ventral and inferior surfaces of the body of the sphenoid bone (fig. 21). These meatuses in a general way possess knees or bends, thus presenting ascending and descending rami. These bends are best marked in the middle and superior meatuses. It is a constant condition in the middle meatus, and a fairly large number of specimens show a well marked ascending ramus for the superior meatus. The remaining meatuses when present, however, do not have well marked ascending rami. In fact, very many specimens give no evidence whatever of individual ascending rami for the meatus suprema I, II, and III (fig. 23). In a general way it may be stated that the differentiation of ascending rami becomes gradually less marked as we pass from the meatus medius to the meatus suprema III (figs. 21, 23, and 25).

The ascending rami. The ascending ramus of the middle meatus is directed rather obliquely, in a ventral and superior direction—this is less so for the corresponding ramus of the

superior meatus. As we pass from the superior meatus to the supreme meatus III we find a rapid change in direction of the ascending rami to a more or less vertical plane, i. e., the ascending rami more nearly vertical to the cribriform plate of the ethmoid bone. We may, therefore, say—when ascending rami are differentiated—that as we proceed from the meatus medius to the meatus suprema III, there is a gradual change in direction of the ascending rami from an oblique to a more or less vertical plane (fig. 21).

In fig. 21 we have the representation of a specimen which presents an ascending ramus for each corresponding meatus. The ascending rami of the supreme meatuses, II and III are, however, not marked, in that the two latter meatuses seldom have well developed knees. In fig. 22 the ascending rami are indicated merely by very shallow, short grooves near the cribriform plate of the ethmoid bone. In the latter case in no instance does an ascending ramus reach the corresponding descending ramus. This doubtless means a lessened degree of differentiation into ethmoidal conchæ in the region of the ascending rami as compared with the corresponding region in fig. 21.

Sometimes there is apparently no attempt at the formation of individual conchæ in the region of the ascending rami, hence in these cases the meatuses—with the exception of the meatus medius—do not possess individual ascending rami (fig. 23). In other instances the meatus superior and medius have ascending rami, but the remaining ethmoidal meatuses do not (fig. 25). The ascending ramus of the meatus superior is occasionally so well developed that it reaches nearly to the cribriform plate of the ethmoid bone (fig. 24).

A reference to figs. 21 to 30 will indicate the irregularity and inconstancy of the ascending rami, with the single exception of the meatus medius. Notwithstanding this inconstancy of the ascending rami, we occasionally have ascending rami as well marked as the descending rami (fig. 24). Rarely we find them all fairly well marked (fig. 21), but in the vast majority of cases the ascending rami of the supreme meatuses vary from an extremely rudimentary state to a complete absence. The number of times the ascending rami are present in some form, however, justifies the division of the ethmoidal meatuses into ascending and descending portions.

The descending rami. The descending rami of the ethmoidal meatuses are as a rule much better differentiated than are the corresponding ascending rami. What has been said of the ascending rami, i. e., a gradual change from an oblique to a more or less vertical plane, as one passes from the meatus medius to the meatus suprema III, applies also, although with less degree, to the descending rami.

The descending ramus of the meatus medius lies practically in a horizontal plane, and the corresponding ramus of the meatus superior varies from it but little in its general direction (fig. 22). On the other hand, the descending rami of the meatus suprema I, II, and III assume a more vertical direction—the latter being most marked in the meatus suprema III (fig. 21). In very many cases the descending rami of the meatus suprema II and III are extremely rudimentary or not at all differentiated (fig. 29). The descending ramus of the meatus suprema I is present in some form, according to my specimens, in practically all cases. Of course after birth the meatus suprema I in many cases becomes obliterated (62.5 per cent of my adult specimens present a meatus suprema I) and in the adult the concha nasalis superior and suprema I are represented by the concha superior. The meatus medius and superior are, of course, constant in both the fetus and in the adult.

In a general way we may say that the integrity of the ethmoidal meatuses present, with the possible exceptions of the meatus medius and superior, depends practically wholly upon the differentiation and degree of development of the descending rami, and not upon the ascending rami (figs. 21 to 24).

THE NASAL CONCHAE.

The concha nasalis inferior. The concha nasalis inferior appears first in the formation of nasal conchæ, and for some time occupies the greater portion of the lateral nasal wall (fig. 13). It is at first not well differentiated, but with the growth of the fold and the deepening of the furrows (meatuses) inferior and superior to it, the concha becomes more sharply outlined. With the growth of the nasal fossa in the dorsal and superior direction, and the resulting development of the ethmoidal region, the concha inferior gradually comes to take

on the usual adult form. During the latter stages of intrauterine life it offers nothing of note to justify a further consideration of it in this connection.

The agger nasi. The agger nasi is homologous with the nasoturbinal which is so well developed in some other forms (pig, cow, sheep, dog, skunk, etc.). It is extremely rudimentary in man in comparison, for example, to the corresponding structure in the pig, rabbit, cow, etc. The agger nasi is an elevation located ventral to the concha nasalis media, and ventral and superior to the concha nasalis inferior. It is more or less parallel to the bridge of the nose. It is at times fairly well developed in the late fetus, and again we find it extremely rudimentary (figs. 22, 25, 29, and 39).

Killian, in conjunction with the processus uncinatus of the ethmoid bone, considers it as an ethmoidal concha, i. e., belonging to the ethmoidal group of conchæ. He considers the processus uncinatus as the descending crus of the agger nasi, and speaks of the two structures as his "erste Hauptmuschel." In commenting on Killian's classification of the nasoturbinal (agger nasi), Peter, who studied the structure from a comparative point of view, says: "Killian und vor ihm Andere glaubten auch dass das Nasoturbinale in das Schema der Riechmuscheln einzwängen zu müssen und suchten daher nach einem Crus descendens desselben, den sie im Processus uncinatus gefunden zu haben meinten. Nach obiger Darstellung der Muschelentwicklung ist diese Forderung ebenso unberechtigt, wie sie für das Maxilloturbinale wäre."

I prefer to think of the processus uncinatus as an accessory concha, and to class it with the folds of the bulla ethmoidalis (also accessory conchæ of the middle meatus) and with the accessory concha of the superior meatus. While the processus uncinatus is more or less continuous with the agger nasi, and for descriptive purposes might be considered as the descending crus of the agger nasi, it is also in many instances fused ventrally and superiorly with the lateral surface of the concha nasalis media. I have also seen it fused across the infundibulum ethmoidale with the ventral extremity of the bulla ethmoidalis. In subsequent paragraphs I will consider the concha nasalis media as Killian's "zweite Hauptmusche'," and will not consider the agger nasi and the processus uncinatus as belonging to the regular group of ethmoidal conchæ.

The concha nasalis media, superior, suprema I, suprema II, suprema III. The regular group of ethmoidal conchæ have many things in common, hence may for the time be considered together. In a general way they all possess knees or bends, thus presenting superior and inferior, or better, ascending and descending portions (Cura ascendens and descendens of Killian). As we pass from the concha media to the concha suprema III, we find a gradual lessening in the degree of the knee or bend. The supreme conchæ represent practically straight angles, hence no well marked division into ascending and descending crura, i. e., the conchæ are practically straight. This is also aided in very many cases by the rudimentary development or complete absence of individual ascending crura (figs. 23 and 29). As we pass from the concha media towards the concha suprema III we find a gradual change in the plane of the conchæ, from a more or less oblique direction to a more or less vertical one (figs. 21 and 23).

The ascending crura. The ascending crura always tend more towards the perpendicular than do the corresponding descending crura. This is especially true of the concha media and superior, also at times of the concha suprema I (figs. 21 and 24). Fig. 21 shows five fairly well marked ascending crura. It will be noticed that they are almost perpendicular to the cribriform plate of the ethmoid bone. However, their superior extremities as individual conchæ do not closely approach this plate. We may either think of the conchæ as fused into one mass, or that differentiation into individual conchae stopped short of the cribriform plate. The tendency of the conchæ to become straighter as one proceeds from the concha media to the concha suprema III is well illustrated in this figure (21).

In other cases the individuality of the ascending crura is only faintly indicated by very shallow grooves throwing into slight relief extremely rudimentary crura. In fig. 22 we have such an example. Here we find the general ascending-crural mass well developed, but the differentiation into five ascending crura, with the single exception of the ascending crus of the concha media, only slightly marked. In some instances the ascending crus of the concha media stands out in bold relief. This is especially due to a well developed ascending ramus of the meatus superior (fig. 24). In the latter figure

EXPLANATION OF FIGURES.

Figs. 21, 22, 23 (× 1.2) Drawings of specimens of the lateral nasal wall from the anatomic series, Cornell University. The drawings all represent the lateral nasal wall of term fetuses.

Compare especially the regions of the ascending crura of the ethmoidal conchae in the three figures. In fig. 21 the ascending and the descending rami of the ethmoidal meatuses are continuous. In fig. 22, however, the very rudimentary ascending rami of the ethmoidal meatuses are not continuous with the descending rami—save in the meatus medius. It will be noticed in fig. 23 that there is no attempt at the differentiation of individual ascending crura for the ethmoidal conchae; the concha media is, however, an exception. In the latter figure the ascending crura are represented by a general ascending crural mass undifferentiated.

Note the extensive furrows on the medial surface of the concha nasalis media in figs. 21 and 22.

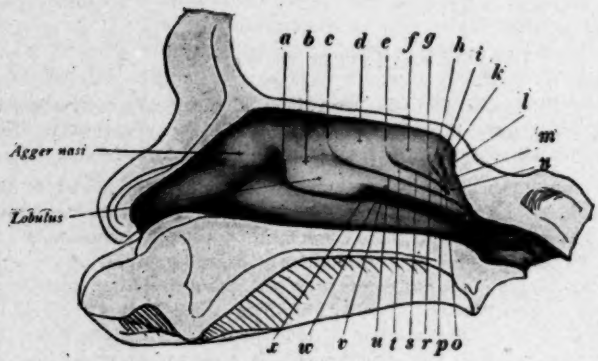
a, c, e, g, i = ascending rami of the ethmoidal meatuses; w, u, s, p, n = descending rami of the ethmoidal meatuses; b, d, f, h, k = ascending crura of the ethmoidal conchae; v, t, r, o, m = descending crura of the ethmoidal conchae; l = sinus sphenoidalis; x = Incisura retrolobularis.

Figs. 24, 25, 26 Drawings of specimens of the lateral wall of the nasal cavity from the anatomic series, Cornell University.

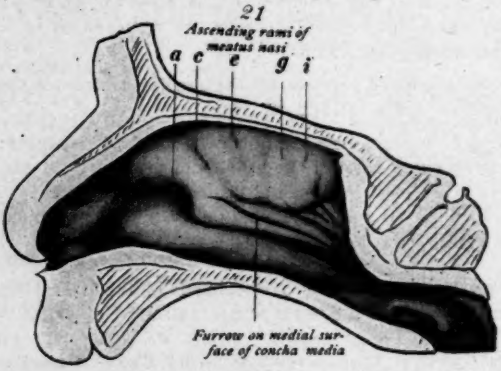
Fig. 24 (× 1.2) From a fetus at term. Shows a marked ascending ramus for the meatus nasi medius. The other ascending rami present are less developed and do not reach the corresponding descending rami. Note also the multiple furrows on the medial surface of the concha nasalis media.

Fig. 25 (× 1.2) From a 7-months fetus. To show the furrows on the concha nasalis media and the lobule in the region of the knee. There is little or no differentiation in the region of the ascending crura for the concha superior and the concha suprema I.

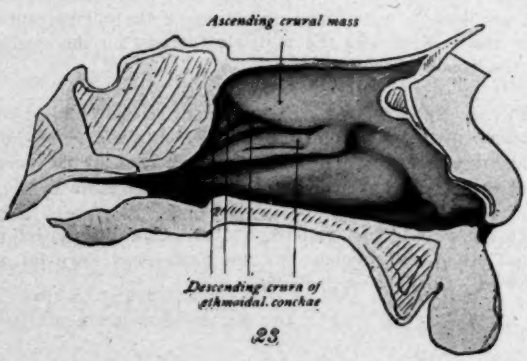
Fig. 26 (× 1.8) From a 190-day fetus. The differentiation into individual ethmoidal conchae has not progressed very far at this early period. Compare with fig. 21.


a b c d e f g h i k l m n
Agger nasi
Lobulus
x w v u t s r p o

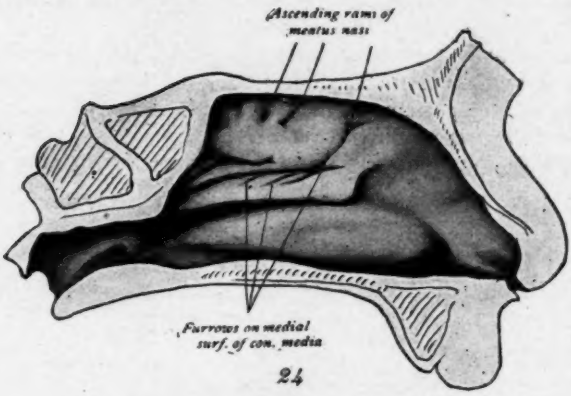
21


Ascending rami of meatus nasi
a c e g i
Furrow on medial surface of concha media

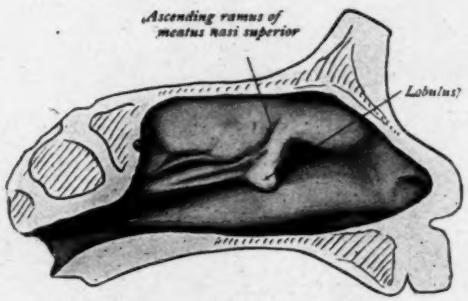
22


Ascending crural mass
Descending crura of ethmoidal conchae

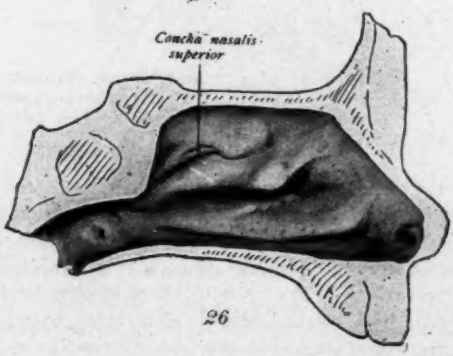
23


Ascending rami of meatus nasi
Furrows on medial surf. of con. media

24


Ascending ramus of meatus nasi superior
Lobulus?

25


Concha nasalis superior

26

the ascending ramus of the meatus superior closely approaches the cribriform plate of the ethmoid bone.

Occasionally the whole ascending-crural mass presents an even and unbroken surface; there being no furrows or grooves to throw any portion of the mass into relief. In such instances there is no differentiation of the mass into individual ascending crura; however, we may consider this mass as rep-

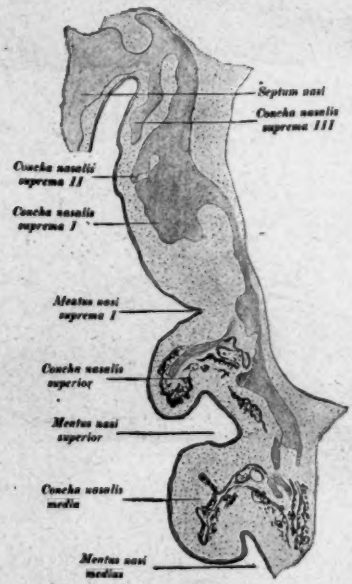
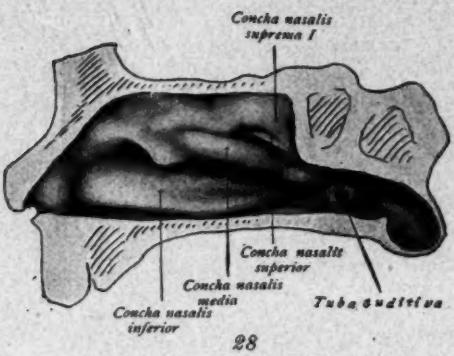
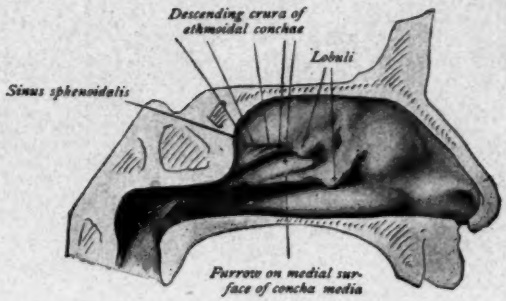


Fig. 27 (× 8) Drawing of a frontal section through the lateral wall of the nasal cavity in the region of the supreme conchae (fetus aged from 7-8 months, series B, slide 48). The concha nasalis inferior is not included in the section.

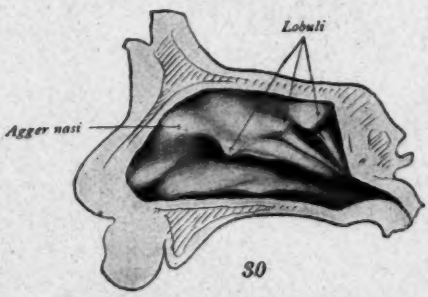
resenting the ascending crura undifferentiated (fig. 23). If not the latter, then we must say that the individual ascending crura coalesced into a general fold or mass at an earlier stage. The former theory is, however, the most plausible, according to my observations. The general ascending-crural mass is often more or less overhanging in character. Again we may have the ascending crura of the concha media and superior



28



29



30

Figs. 28, 29, 30 Drawings of specimens of the lateral wall of the nasal cavity from the anatomic series, Cornell University.

Fig. 28 (× 1.8) From a 190-day fetus. Note especially the rudimentary character of the concha superior. The accessory concha of the superior meatus cannot be seen.

Fig. 29 (× 1.2) From a 235-day fetus. Note the marked differentiation into descending crura of the ethmoidal conchae. The ascending crural mass is as yet undifferentiated.

Fig. 30 (× 1.2) From a 210-day fetus. Note especially the lobuli on the ethmoidal conchae.

well outlined, while the supreme group (I, II, III) is represented by one fold (fig. 29).

A reference to figs. 21 and 30 will show some of the different combinations met with in the fetal sepcimens examined for the substance of this paper.

The descending crura. The descending crura of the ethmoidal conchæ are, almost without exception, better differentiated than are the corresponding ascending crura. The former also occupy a more nearly horizontal plane; this, however, lessens as we approach the concha suprema III. The middle and superior conchæ present the best marked descending crura. The concha suprema I also frequently possesses a well marked descending crus. The descending crura of the conchæ supremæ II and III are variable and frequently entirely wanting. At times the latter two are fused into one, and then in turn closely associated with the anterior surface of the body of the sphenoid bone, in the region of the developing sinus sphenoidalis. The concha suprema III loses its identity early by becoming associated with the anterior surface of the body of the sphenoid bone.

Lobules and nodules of the ethmoidal conchae. At the junction of the ascending and descending crura, or in the region of the knees, we frequently find overhanging lobule formations. This is a fairly constant condition for the concha media, and it is also very common for the concha superior (figs. 21 and 28). Occasionally the concha suprema I also presents a similar formation, which in some cases more or less overhangs the supreme meatuses and conchæ. In the latter case it really amounts to the ascending crura of the supreme conchæ (fig. 30). Schwalbe in his "Anatomie der Sinnesorgane," refers to the lobule of the concha nasalis media as the "Operculum meatus narium medii." He does not, however, refer to similar formations of some of the other conchæ. Frequently there is a secondary thickening on the middle of the lobules. Zuckerkandl calls attention to this for the lobule of the concha media; however, the other lobules frequently present the same condition (figs. 25 and 30). Killian refers to this secondary prominence as the "Nodulus lobuli." Fig. 30 shows three well formed lobules—the superior one more or less operculating the conchæ and the meatuses in the immediate vicinity. The lobule of the concha media is at times

very prominent, and it takes on different shapes, as is evidenced by figs. 21 and 25.

My studies have led me to agree with the statement of Peter, namely, that "Dieser Lobulus mit Nodulus ist der vorderen Spitze der Ethmoturbinalia der Säugetiere zu vergleichen."

Grooves on the concha nasalis media. The concha nasalis media needs further consideration separately, since it presents grooves or furrows on its medial and inferior surfaces (figs. 22, 23, and 25). These furrows which show on the mucous membrane covering the concha, generally present corresponding depressions in the conchal cartilage or bone. At times we find marked furrows on the conchal cartilage, yet the surface remains unfurrowed in these positions. Killian concludes, therefore, that "der Knorpel scheint demnach weit conservativer in der Bewahrung der ursprünglichen Form zu sein, als die Schleimhaut."

The two most constant of these furrows according to my specimens are what may be termed, (1) the superior and (2) the inferior (fig. 25). In fig. 22 we have an extensively developed superior furrow. It more or less splits the descending crus of the concha media into superior and inferior portions. The latter condition led some former investigators (Zuckerkandl and others) erroneously to consider the deep furrow as one of the chief ethmoidal furrows, and the portion of the concha media superior to the furrow, as a separate ethmoidal concha (mittlere Siebbeinmuschel, Zuckerkandl). Seydel later showed the error of this contention, and Zuckerkandl subsequently retracts from his former view in the following words: "Dagegen möchte ich das Gleiche für die untere Siebbeinmuschel nicht mehr aufrecht erhalten, denn wir haben erfahren, dass die mittlere Siebbeinmuschel nicht nur aus einer Teilung der Concha ethmoidalis inferior hervorgeht. . . . . und stimme O. Seydel bei, der die untere Siebbeinmuschel als Repräsentantin eines einzigen Riechwulstes ansieht."

Killian refers to the furrows of the concha media as "Nebenfurchen," and the notch formed by the inferior furrow differentiating to the free inferior border of the concha media, dorsal to the lobule of the knee, as the "Incisura retrolobularis" (fig. 21). Sometimes the superior furrow is broken into three or more grooves, rather obliquely placed, the ventral one being as a rule the best marked (fig. 24).

ACCESSORY NASAL FOLDS (CONCHAE) AND FURROWS.

Upon turning superiorly the concha nasalis media of the adult nose we expose for study the bulla ethmoidalis and the processus uncinatus—accessory conchæ of the meatus nasi medius. By removing the concha nasalis superior we also expose in very many cases an accessory fold or concha on the lateral wall of the meatus nasi superior which is comparable to the bulla ethmoidalis. These structures contained in the middle and the superior meatuses are hidden or accessory nasal conchæ, comparable to the accessory conchæ found in mammals. In the middle meatus we also note the hiatus semilunaris, and if the processus uncinatus be turned inferiorly the infundibulum ethmoidale is exposed. In the superior and ventral portion of the middle meatus we note varying relations in different specimens between the nasofrontal duct and the infundibulum ethmoidale and some of the anterior ethmoidal cells. The ostia of ethmoid cells are also to be seen in the meatus medius, superior, and suprema I—the relations of these ostia varying much in different specimens.

In order to interpret these varying adult conditions and relations, it is essential that we study the developmental changes in the middle and the superior meatuses at some length in the embryo, late fetus, and in the young child. This will at once point out the probabilities of development and the varying adult conditions one may expect to meet in a series of specimens.

The accessory folds and furrows of the descending ramus of the meatus nasi medius. If we examine serial frontal sections of the nose of a 40-day embryo we will find that the lateral wall of the meatus nasi medius is more or less even and simple. If, on the other hand, we examine the same region in embryos aged from 50 to 60 days we will find a somewhat crescentic shaped fold with its free border directed superiorly, breaking the evenness of the wall. The latter is the anlage of the processus uncinatus and the first of the series of accessory folds to appear on the lateral wall of the meatus medius. This fold at once aids in forming a furrow immediately superior to it—the primitive infundibulum ethmoidale. It is quite probable that the furrow first establishes an anlage and this in turn throws into slight relief a portion of the mucous membrane inferior to it, thus establishing the anlage of the pro-

cessus uncinatus. It may, however, be said that both structures are more or less dependent upon each other in establishing anlages. The same principles are obviously here involved just as they are in forming the primitive nasal meatuses and conchæ.

From this furrow (primitive infundibulum ethmoidale) the sinus maxillaris develops its anlage in the form of an evagination of the mucous membrane. This maxillary sinus anlage begins to be established from the sixty-fifth to the seventieth day of embryonal life. In a former paper I suggested that primitively the pouching of the sinus maxillaris aided in deepening the infundibulum ethmoidale; thus causing the processus uncinatus to stand out better at an early period.

Shortly after this we have the first evidence of the bulla ethmoidalis, appearing superior and lateral to the processus uncinatus. The bulla ethmoidalis is first indicated by special thickenings (one or two) of the lateral plate of cartilage—the cartilaginous thickenings appearing on its medial surface. At first the bullar anlages do not cause the mucous membrane to bulge towards the lumen of the nasal cavity; hence these early stages pass unobserved unless one examine serial frontal sections through this region. Later, however, say in a 120-day embryo, the cartilaginous prominences have developed sufficiently to push the mucous membrane on the lateral wall of the meatus medius into relief (figs. 17 and 18). We now have established a fold, or folds (bullar folds), lateral and superior to the processus uncinatus. If two folds appear there is an intervening furrow. These folds represent the primitive bulla ethmoidalis. Usually the intervening furrow, when present, disappears after birth. Occasionally, however, an ethmoidal cell develops from this furrow.

Thus far no mention has been made of another fold that appears in many cases inferior to the bullar folds and lateral to the infundibulum ethmoidale. Because of its relations to the infundibulum ethmoidale I shall speak of this as the infundibular fold. It is never very prominent and forms in part the lateral wall of the infundibulum ethmoidale. It may persist as a fold after birth, but it generally becomes leveled down to an even surface which imperceptibly passes on to the bullar surface.

It will, therefore, be seen that we have, during the latter

half of intrauterine life, fairly well outlined grooves and folds on the lateral wall of the descending ramus of the meatus medius. If we take into consideration the extreme cases found in the late fetus we have thus formed four folds and four furrows. These folds may appropriately be named superior and inferior bullar folds, infundibular fold, and processus uncinatus; the furrows, the suprabullar furrow or recess, the bullar furrow, the infrabullar furrow, and the infundibulum ethmoidale. The suprabullar recess and the infundibulum ethmoidale are constant and are the most important furrows. The others are of less importance and are more irregular and inconstant in their development (figs. 31 and 34).

Killian, who has studied this region extensively, finds a similar number of folds and furrows on the lateral wall of the middle meatus. He, however, considers the processus uncinatus as the descending crus of his "erste Hauptmuschel," hence includes it in the class of regular ethmoidal conchæ. My superior bullar, inferior bullar, and infundibular folds or conchæ correspond to his "obere, mitt'ere, und untere Nebenmuscheln," respectively. My suprabullar, bullar, and infrabullar furrows, and infundibulum ethmoidale correspond to his "Recessus superior, obere Zwischenfurche, untere Zwischenfurche, und Recessus inferior," respectively.

The suprabullar furrow or recess. The suprabullar furrow or recess is practically constant. It varies somewhat in its form and extent, but all specimens give some evidence of it. At times it continues ventrally and superiorly almost to the cribriform plate of the ethmoid bone (fig. 38); however, in the majority of cases it does not extend so far, due to partial fusion between the superior border of the superior bullar fold and the attached border of the concha media (fig. 41). It is frequently also limited inferiorly and dorsally by similar fusion. Again, there may be multiple points of fusion between the superior bullar fold and the concha media, thus breaking the suprabullar recess or furrow into several compartments (fig. 43). The recess in many cases early tends to deepen or pouch laterally and inferiorly behind the bullar folds (fig. 35). In this manner the bulla becomes more or less shell-like in structure; and some of the so-called bullar cells are thus established. The suprabullar recess is a constant point from which anterior ethmoidal cells develop (figs. 31, 34, and 43).

The bullar furrow. The bullar furrow is placed between the two bullar folds or accessory conchæ (fig. 31). It is variable in its differentiation and not at all constant. It is generally obliterated by the superior and the inferior bullar folds becoming continuous structures in the formation of the adult bulla ethmoidalis. This coalescence is, however, not always absolute, in that an ethmoidal cell may develop from the furrow, leaving the ostium of the adult cell at the point of the primitive furrow (figs. 31 and 39). Even in many adult specimens we find evidences of this primitive furrow in the form of a shallow groove on the medial surface of the bulla ethmoidalis. An ethmoidal-cell ostium on the medial surface of the bulla ethmoidalis is almost invariably the remains of the early bullar furrow.

The infrabullar furrow. The infrabullar furrow is placed between the inferior bullar and the infundibular folds (fig. 31). It is very inconstant and when present is frequently obliterated by the inferior surface of the bulla ethmoidalis becoming continuous with the infundibular fold. In some cases it is fairly well marked (fig. 34), but, as a rule, it is of minor importance. Rarely an ethmoid cell develops from the furrow—the adult cell draining into the infundibulum ethmoidale.

The infundibulum ethmoidale. The infundibulum ethmoidale (Recessus inferior der absteigenden Schenkel der ersten Hauptfurche of Killian) is invariably present in some form. It is formed early, and obviously aids in establishing the primitive processus uncinatus. It is directed somewhat ventrosuperiorly and at its ventral and superior termination it may end blindly or develop into an anterior ethmoid cell. At other times it is variously continued into one of the frontal furrows. Rarely it continues its development ventrally and superiorly, remaining lateral to the frontal furrows, and in this way may establish the frontal sinus (figs. 36, 37, 39, and 40).

Dorsally and inferiorly it either gradually loses its depth and thus becomes continuous with the middle meatus, or it ends rather abruptly in a pocket, due to the superior and lateral curving of the dorsal end of the processus uncinatus at this point (fig. 49). From the infundibulum ethmoidale the sinus maxillaris develops, hence in the adult the latter sinus com-

municates with the infundibulum ethmoidale, and only indirectly via the hiatus semilunaris with the meatus nasi medius fig. 18).

The superior bullar fold or concha. The superior bullar fold or concha is located immediately inferior to the suprabullar recess (fig. 31). It may continue independently ventrally and superiorly almost to the cribriform plate of the ethmoid bone.

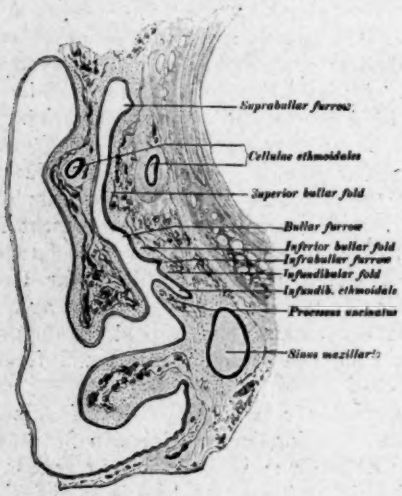
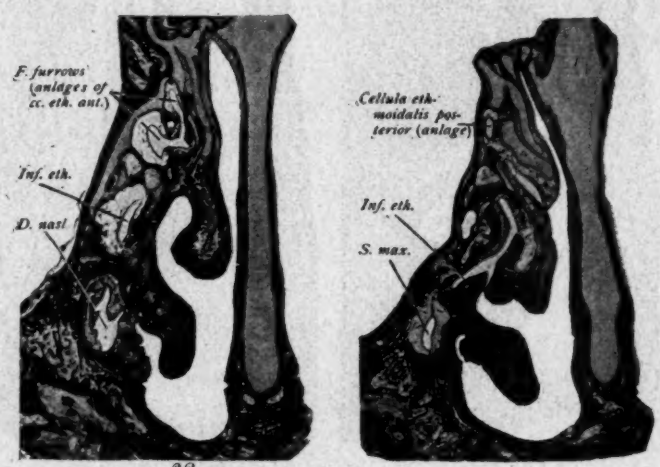


Fig. 31 (× 3.9) Drawing of a frontal section of the left nasal fossa of a term fetus (series D, slide 5).

Note the individual folds comprising the bulla ethmoidalis, and the fold lateral to the infundibulum ethmoidale, and the furrows that border these folds. The cell that is indicated in the superior bullar fold is an extension from the suprabullar furrow, and the cell indicated in the concha media communicates a few sections farther dorsally with the meatus nasi medius (compare with fig. 35).

In other cases it may be fused at certain points with the attached border of the concha nasalis media (figs. 41 and 43). It is frequently continuous with one or more frontal folds (fig. 41). It usually comes to form the chief bulk of the adult bulla ethmoidalis. In many cases there is no differentiation into superior and inferior bullar folds by an intervening furrow—the bullar furrow.

The inferior bullar fold or concha. The inferior bullar fold or concha is, as stated above, not always differentiated from the superior bullar fold. It is, however, occasionally well isolated and stands more or less as an independent fold (figs. 34 and 39). The latter condition is especially marked in the cases where an anterior ethmoid cell develops from the bullar furrow (fig. 39). I agree with Killian that the superior and inferior bullar folds (obere und mittlere Nebenmuscheln, Kil-



32 33

Figs. 32 and 33 Photomicrographs of frontal sections through the right nasal fossa of a 7-months fetus (series B, slide 31). Section fig. 32 is through the ventral portion, and section fig. 33 is through the dorsal portion of the fossa.

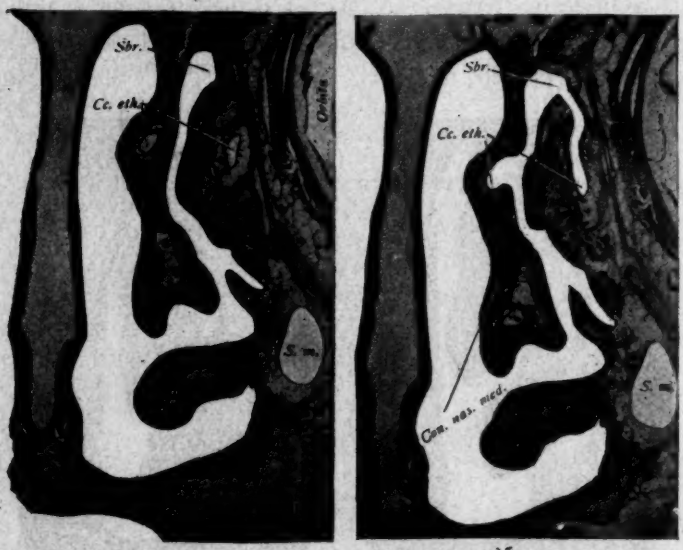
The frontal furrows have pouched towards the frontal region in the establishment of early anterior ethmoid cells (fig. 32).

See page 324 for explanation of lettering.

lian) usually coalesce to form the adult bulla ethmoidalis. Sometimes, even in the adult, we see evidences of the primitive bullar furrow, which more or less grooves the medial surface of the adult bulla. In many instances coalescence is, however, not necessary because there was at no time a differentiation into two portions.

The infundibular fold or concha. The infundibular fold is very rudimentary and more or less inconstant. It is located

lateral to the infundibulum ethmoidale and in part forms its lateral wall (fig. 35). It is more or less separated from the inferior bullar fold by the shallow infrabullar furrow. It usually loses its identity in the adult, in that it imperceptibly



34 35.

Fig. 34 and 35 Photomicrographs of frontal sections through the left nasal fossa in the region of the bullar folds from a term fetus (series D, slides 5 and 6). Note the bullar folds, the cells in the concha media, and the superior bullar fold in fig. 34. In fig. 35, which is a section farther dorsal, the ostia of the cells are shown. It shows how the suprabullar furrow or recess tends to develop or pouch behind and lateral to the bullar folds; this in time causes the bulla to become shell-like.

F. furrows, = frontal furrows; Cc. eth. ant., = cellulae ethmoidales anterior; Inf. eth., = infundibulum ethmoidale; D. nasal., = ductus nasolacrimalis; S. max., = sinus maxillaris; Sbr., = suprabullar recess or furrow; Cc. eth., = cellulae ethmoidales; S. m., = sinus maxillaris; Con. nas. med., = concha nasalis media.

passes to the bullar surface by the obliteration of the infrabullar furrow. Occasionally it is well marked and is more or less isolated from the inferior bullar fold by a relatively deep infrabullar furrow. Rarely it retains its identity in the adult

—this is especially so when an anterior ethmoidal cell develops from the infrabullar furrow.

The processus uncinatus. The processus uncinatus is a constant structure, and is medial and inferior to the infundibulum ethmoidale. As was stated before, it is the first of the accessory or hidden conchæ to be differentiated. At its ventral and

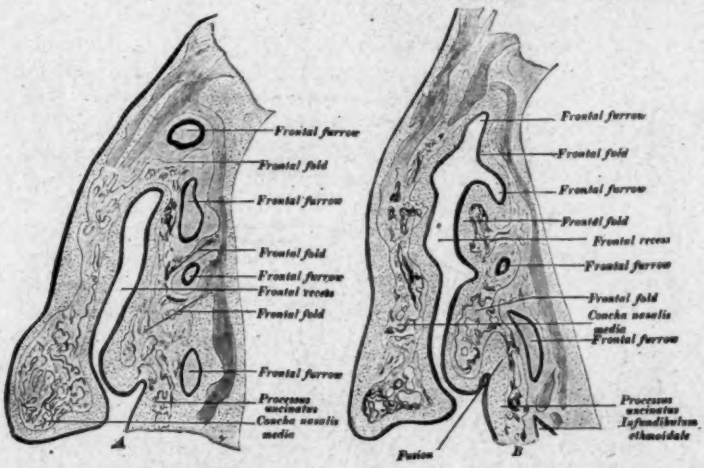


Fig. 36 (× 8) Drawings of frontal sections through a portion of the lateral nasal wall of a 7-months fetus, in the region of the frontal recess (series C, slide 5). Section A is farther ventral than is section B.

Note the blind ventral extremities of the frontal furrows in section A which, at this plane of section, are in reality early anterior ethmoidal cells. Any one of these cells may develop into a frontal sinus, or two may develop sufficiently far to be called frontal sinuses. The frontal recess may also develop into the frontal sinus.

In section B some of the furrows communicate freely with the frontal recess, and at this plane of section are more truly frontal furrows.

superior end it terminates in various ways. In some cases it is continuous with one or more frontal folds and at the same time its base continued on to the agger nasi (fig. 41). In other instances it is fused with the lateral surface of the concha media at its ventral extremity, or even fused with the ventral extremity of the bullar folds. Ventrally and inferiorly the

base of the processus uncinatus becomes continuous with the surface of the agger nasi. Some observers class the processus uncinatus with the general ethmoidal conchæ.

The accessory folds and furrows of the ascending ramus of the meatus nasi medius, i. e., of the recessus frontalis. In a

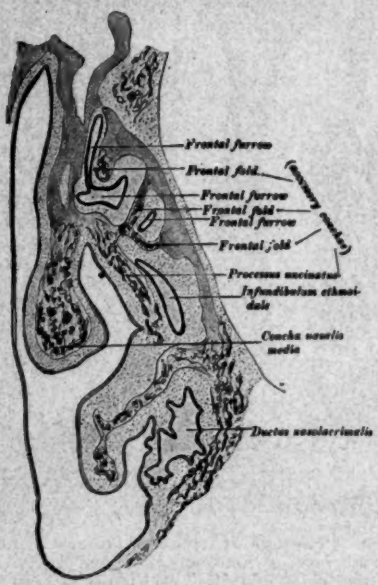


Fig. 37 (× 5) Drawing of a frontal section through the left nasal fossa of a fetus aged approximately 7 months (series B, slide 31). The section is in the region of the frontal recess.

Note the frontal folds (accessory conchae) and the frontal furrows. Some of the furrows, either by coalescence of the folds or by the extension of the furrows towards the frontal region, end blindly and represent early anterior ethmoid cells. The frontal recess is really obliterated by the coalescence of some of the frontal folds with the lateral surface of the concha nasalis media—compare this condition with that found in fig. 36 B.

previous paragraph mention was made of the rather early beginning of an extension of the meatus nasi medius from its ventral and superior part. This extension of the middle meatus towards the frontal region is the first step in the formation of the frontal sinus and certain of the anterior ethmoid

cells. To this extension or recess Killian has given the appropriate name, "Recessus frontalis." For some time the lateral wall of this recess (ascending ramus of the middle meatus) is even and unbroken. If we examine frontal and horizontal sections of the recess of a 4-months fetus we will find the lateral plate of cartilage thickened at certain points, in the form of projections directed towards the lumen of the nasal fossa. For some time this condition prevails and the mucous membrane is not at first thrown into relief. These thickenings, which I find vary in number, are in anticipation of the folds (accessory conchæ) which are present on the lateral wall of the frontal recess of a later fetus.

The folds as found in the late fetus are variable in number and as a rule are not very prominent. Their prominence depends largely upon the degree of development of the intervening furrows or pits. The folds as a rule more or less lose their identity after birth, and the furrows or pits variously remain as ostia of anterior ethmoid cells. The folds have been appropriately termed frontal folds or conchæ, and the bordering furrows or pits, frontal furrows.

The frontal folds and furrows vary in degree of development and differentiation. We frequently find specimens with four well formed furrows and three resulting folds (fig. 41). In other cases, either by earlier coalescence or, I think better, by a lessened degree of differentiation, we have a smaller number of folds and furrows (fig. 40). In fig. 41 it will be noticed that the processus uncinatus is continuous with the first and second frontal folds. The processus uncinatus in the latter case also sends a fork towards the agger nasi, and gains slight fusion with the lateral surface of the concha nasalis media. The superior bullar fold is in part directly continuous with what might be termed the third frontal fold. In fig. 38 we find that the processus uncinatus is continued ventrally and superiorly to the agger nasi; in part fusing with the concha nasalis media at this point. The superior and inferior bullar folds in the latter instance are continued superiorly to become continuous with the first and second frontal folds. Note that the third frontal furrow is more or less continuous with the suprabullar recess, and that the latter recess continues almost to the cribriform plate of the ethmoid bone. The infundibulum ethmoidale continues ventrally and superiorly

into a frontal furrow. Compare this condition of the infundibulum ethmoidale with that found in figs. 39 and 41.

In fig. 40 there is only one frontal fold or concha differentiated. The concha is bordered by two frontal furrows, and the infundibulum ethmoidale is continued ventrally and superiorly into these furrows. In fig. 39 the processus uncinatus is continued ventrally on the lateral wall of the frontal recess and apparently the frontal folds extend from it. In the latter figure note also the relations of the infundibulum ethmoidale in the region of the frontal recess, and the superior and inferior bullar folds and the infundibular fold.

At times the frontal folds or conchæ fuse with the lateral surface of the concha nasalis media, and in this manner we have the obliteration of the frontal recess. In such cases the sinus frontalis must develop from an anterior ethmoid cell, and not by direct extension of the frontal recess (fig. 44). In fig. 36 the frontal folds have not fused with the lateral surface of the concha nasalis media and, therefore, the frontal recess is maintained. In such a condition the sinus frontalis may develop either from the frontal recess or from one or more anterior ethmoid cells. It is difficult to say in the latter figure whether the frontal folds or conchæ have coalesced with one another, thus constricting off small blind pouches (early anterior ethmoid cells), or whether the frontal furrows in anticipation of anterior ethmoid cells have pouched toward the frontal region, thus closely simulating coalescence between the several frontal folds, but making coalescence only apparent rather than real.

A comparison of figs. 36 to 42 (showing both frontal sections and surface views of the frontal recess and the descending ramus of the meatus medius) will materially aid in clearing up the various adult conditions one meets in these regions, in connection with the gross anatomy and relations of the nasofrontal duct, the infundibulum ethmoidale, and the bulla ethmoidalis.

The accessory fold or concha of the meatus nasi superior. At this juncture mention must again be made of a rather frequent accessory concha that is differentiated rather early on the lateral wall of the descending ramus of the meatus nasi superior (fig. 45). Seydel directs attention to it in the following words: "Bei menschlichen Embryonen fand ich einige

Male in dem Spalt zwischen der mittleren und obern Muschel, also an der Stelle, wo bei den Halbaffen die zweite Nebenmuschel liegt, eine niedrige leistenförmige Erhebung der seitlichen Nasenwand . . . Ich möchte diese Bildung als Rest der Nebenmuschel deuten."

The anlage of this accessory concha is indicated rather early, and by the fourth month of fetal life it is well established (fig. 19). Killian considers this fold important as a point for orientation: "Die Nebenmuschel im Bereiche der zweiten Hauptfurche ist, wenn nachweisbar, ein vorzügliches Orientirungsmittel namentlich zur Bestimmung des Crus descendens 3," i. e., the crus descendens of my concha nasalis superior. Some earlier writers thought that the concha superior developed or became differentiated from the concha media—this because of the furrow that is very frequently found on the medial surface of the descending crus of the concha media in the fetus (fig. 22). Seydel later pointed out the error of this contention, and Zuckerkandl agreed that he previously was in error in saying that the "mittlere Siebbeinmuschel" (concha superior) was differentiated from the "untere Siebbeinmuschel" (concha media). Zuckerkandl then advances the theory "dass die mittlere Siebbeinmuschel nicht nur aus einer Teilung der Concha ethmoidalis inferior hervorgeht, sondern über derselben und unabhängig von ihr sich entwickelt und als Rudiment in der unteren Siebbeinspalte steckend angetroffen wird." It appears that Zuckerkandl in speaking of the variations of the "mittlere Siebbeinmuschel," at times mistakes the accessory concha of the superior meatus for his "mittlere Siebbeinmuschel" (concha nasalis superior). What he designates as the "Anlage der mittleren Siebbeinmuschel" (Tafel VII, Fig. XI, Normale und pathologische Anatomie der Nasenhöhle und ihrer pneumatischen Anhänge, Bd. I, Wien und Leipzig, 1893), certainly corresponds to my accessory concha of the superior meatus, and not to my concha nasalis superior.

In case the accessory concha of the superior meatus is well developed we have fairly well formed superior and inferior recesses. The inferior recess is especially deep in the cases where the "crista suprema" of Killian is well developed (fig. 45). This condition makes the superior meatus look much like the middle meatus, i. e., the accessory concha of the su-

perior meatus takes the place of the bulla ethmoidalis (accessory concha of the middle meatus), and the "crista suprema" takes the place of the processus uncinatus (compare figs. 18 and 45).

The inferior recess of the superior meatus may continue superiorly and ventrally into the blind superior termination of the superior meatus. The accessory concha is, however, at times wholly or in part coalesced with the concha media, thus obliterating wholly or partly the inferior recess. Frequently a posterior ethmoidal cell develops from the inferior recess. The superior recess is often obliterated by coalescence between the accessory concha and the concha superior. In other instances the superior recess may be continued ventrally and superiorly to the blind end of the meatus superior. Occasionally an ethmoid cell develops from this recess.

IV. The Anlages of the Sinus Paranasales.

After the preceding consideration of the meatus nasi and the conchæ nasales, and the accessory folds and furrows, the genesis of the sinus paranasales becomes much simplified and fairly easy of interpretation. That all of the paranasal chambers develop from preformed or pre-existing furrows is certainly in accord with my observations. Since the paranasal or accessory cavities develop from preformed furrows and recesses, it is difficult to say just when they begin to establish anlages. I, however, believe that anlages are established much earlier than is generally supposed—in fact, the furrows and recesses from which the paranasal sinuses develop are in a sense the "primitive" anlages of these chambers. The early tendency for the sinuses to establish their "first" anlages may be no mean factor in making the recesses and furrows what they early are.

The pre-existing spaces from which paranasal air chambers may develop, according to my studies, are: (1) the suprabullar recess, (2) the bullar furrow, (3) the infrabullar furrow, (4) the infundibulum ethmoidale, of the descending ramus of the meatus nasi medius; (5) the frontal furrows, (6) the frontal recess, of the ascending ramus of the meatus nasi medius; (7) the ventral and superior extremity of the meatus nasi superior, (8) the recessus superior, (9) the recessus in-

EXPLANATION OF FIGURES.

Figs. 38, 39, 40 Drawings from dissections of specimens from the anatomic series, Cornell University. The dissections have been made with special reference to the furrows and folds on the lateral surface of the frontal recess, and the bullar folds on the lateral wall of the descending ramus of the meatus medius. The specimens are from term fetuses.

Fig. 38 (× 1.8) The concha media has been partly cut away so as to expose the frontal recess and its structures and the bullar folds and furrows. The processus uncinatus has also been partly cut away so as to get a better exposure of the bullar folds and the primitive sinus maxillaris.

Fig. 39 (× 1.2) The concha media has been partly cut away, thus securing a good exposure of the frontal recess with its folds and furrows, and the folds and furrows of the bulla ethmoidalis. The infundibular fold is also well shown in the drawing.

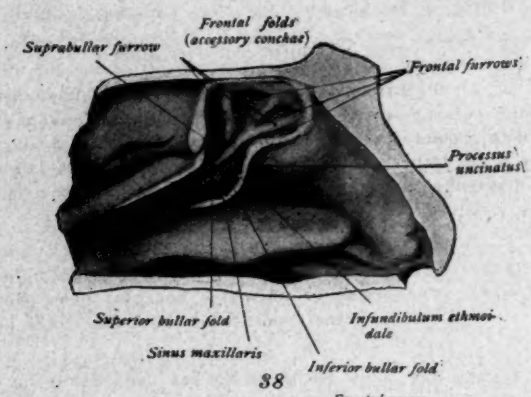
Fig. 40 (× 1.2) Especially note the frontal recess and the low degree of differentiation of frontal folds as compared with the specimens represented in figs. 38 and 39. The processus uncinatus is too large to allow the inferior bullar fold to be seen. Portions of the concha media and superior have been cut away.

Figs. 41, 42, 43 Drawings from dissections of specimens from the anatomic series, Cornell University. The dissections have been made with especial reference to the ascending and descending rami of the meatus medius. The concha media is partly cut away in all the specimens.

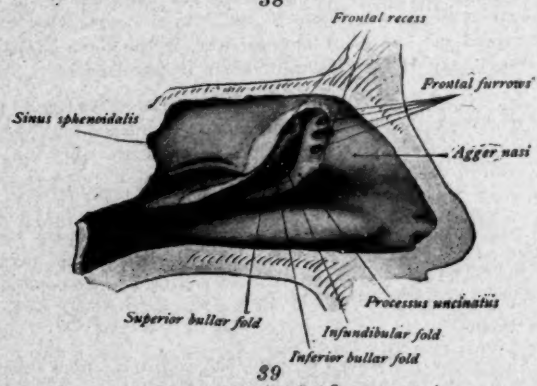
Fig. 41 (× 1.2) Shows the well formed frontal folds (conchae) and furrows on the lateral wall of the frontal recess, also the accessory concha of the meatus superior. From a term fetus.

Fig. 42 (× 1.2) Note the manner of pouching of the frontal furrows and the frontal recess in the formation of anterior ethmoidal cells and the frontal sinus; also the developing sinus sphenoidalis. This specimen was from a child aged approximately five months.

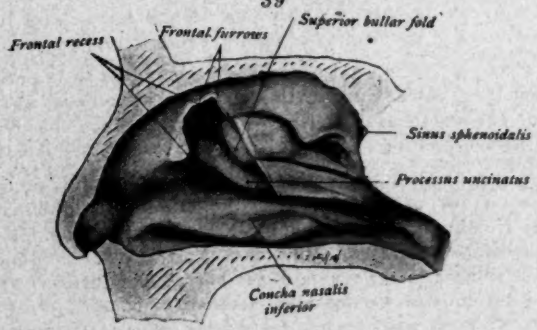
Fig. 43 (× .6) In this specimen there were apparently no frontal folds nor furrows, or they were early obliterated. It will be noticed that the frontal recess is expanding towards the frontal region in the establishment of the frontal sinus. Note also the multiple ethmoid cell anlages in the region of the suprabullar furrow. From a child aged approximately fourteen months.


Frontal folds (accessory conchae)
Suprabullar furrow
Frontal furrows
Processus uncinatus
Superior bullar fold
Infundibulum ethmoidale
Sinus maxillaris
Inferior bullar fold

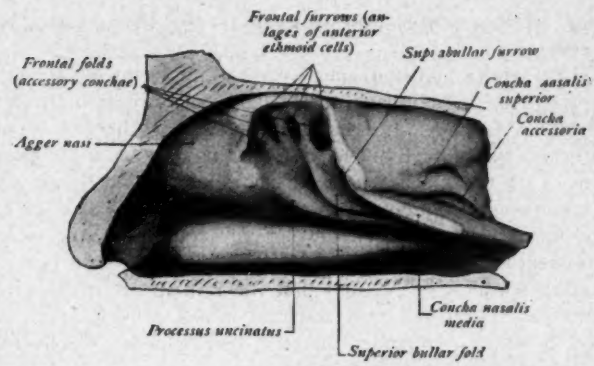
38


Frontal recess
Frontal furrows
Sinus sphenoidalis
Agger nasi
Processus uncinatus
Superior bullar fold
Infundibular fold
Inferior bullar fold

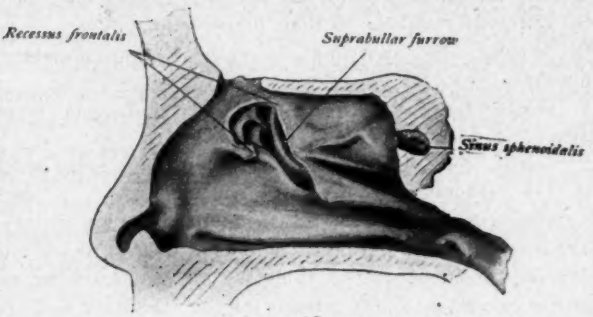
39


Superior bullar fold
Frontal recess
Frontal furrows
Sinus sphenoidalis
Processus uncinatus
Concha nasalis inferior

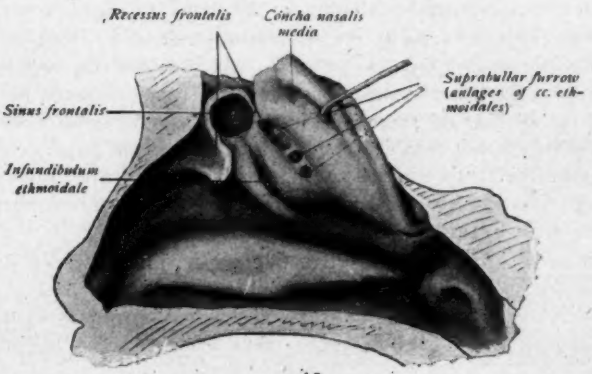
40


Frontal furrows (anlages of anterior ethmoid cells)
Frontal folds (accessory conchae)
Agger nasi
Suprabullar furrow
Concha nasalis superior
Concha accessoria
Concha nasalis media
Processus uncinatus
Superior bullar fold

41


Recessus frontalis
Suprabullar furrow
Sinus sphenoidalis

42


Recessus frontalis
Concha nasalis media
Suprabullar furrow (anlages of cc. ethmoidales)
Sinus frontalis
Infundibulum ethmoidale

43

ferior, of the meatus nasi superior; (10) the meatus nasi suprema I.

Of the above named spaces we rarely find air cells developing from the infrabullar furrow, and only occasionally from the bullar furrow. I, however, find that rather frequently posterior ethmoid cells develop from the inferior and superior recesses of the meatus nasi superior, and about 75 per cent of specimens in which the meatus suprema I persists we find a posterior ethmoidal cell developing from the latter meatus (the meatus nasi suprema I is present in about 62.5 per cent of adult specimens). I find that the remainder of the aforementioned spaces are quite constant in cell development. We must, however, remember that the development of cells from the frontal furrows and recess is very variable.

Because the anlages of the paranasal chambers have primitively different relations, Killian divides them thus:

"1. solche, die zwischen je zwei Hauptmuscheln (I. Ordnung);

2. solche, die zwischen einer Haupt- und einer Nebenmuschel (II. Ordnung) und

3. solche, die zwischen je zwei Nebenmuscheln gelegen sind (III. Ordnung)."

Varying views have been advanced by different writers as to the genesis of the parnasal chambers. Dursy thought that the establishment of all the accessory air spaces of the nose, with the exception of the anlages of the maxillary and sphenoidal sinuses, was wholly dependent upon resorptive processes taking place in the cartilaginous and bony framework of the nose. This is certainly not the earliest factor involved in the establishment of anlages. Others, who worked this region in some of the lower forms, considered the space included by the lateral curling of some of the conchæ as ethmoidal cells—a view that is not tenable. Seydel in a subsequent paper, comes nearer the truth when he writes: " . . . ihre Entwicklung von den Spalten zwischen je zwei (auch rudimentären) Muscheln ausgeht."

Killian in '96, in an exhaustive paper, places to my mind the genesis of the paranasal chambers on a sound basis. My observations in the main agree with his. Whether, as Killian's schemata suggest, coalescence takes place between neighbor-

ing folds and conchæ, thus constricting off a portion of the respective furrow to become the anlage of a cell, seems to me a difficult problem to solve. I rather hold that the nasal mucous membrane in the position of the furrow pouches in the direction of a future cell—this closely simulating coalescence of neighboring accessory folds, or an accessory fold and a concha at these points. There seems to be an inherent tendency for the nasal cavity early to enlarge its surface area by the formation of furrows, folds, and pouches. It indeed seems difficult to decide whether, for example, in figs. 36 and 44, the frontal folds or conchæ coalesced with each other, thus forming blindly ending furrows, or whether the frontal furrows pouched in the frontal direction, thus simulating coalescence but making it only apparent rather than real. It, however, matters very little what interpretation we place here —probably both factors are more or less involved—the fact remains that from these pre-existing furrows and recesses the accessory air spaces develop. This is true of all the paranasal chambers with the single exception of the sphenodial sinus, which is at first, as former writers have pointed out, nothing but a constriction from the dorsal and superior portion of the nasal fossa. Of course the factors of growth (of the sac) and resorption (of surrounding tissue) are early brought into play (fig. 20).

THE SINUS MAXILLARIS.

The sinus maxillaris is primitively merely a pouching or evagination of the mucous membrane of the infundibulum ethmoidale. This pouching is very evident about the seventieth day of fetal life, and is best shown by reconstructing the infundibulum ethmoidale. The earliest changes in its anlage-formation are so slight that they are difficult of appreciation by an examination of serial sections only. The anlage of the sinus maxillaris is usually represented by a single pouch, but, as I stated in a previous paper, we sometimes find two pouches growing side by side from the infundibulum ethmoidale. Again the pouching may be very extensive, and in these cases it is indeed hard to say where the infundibulum ethmoidale ends and where the anlage of the sinus maxillaris begins. In such cases the infundibulum ethmoidale is in a sense a part of the sinus maxillaris. Seydel makes the general statement

that "der Raum des Infundibulum, der zwischen Processus uncinatus und Orbitalwand liegt, ist als ein Theil des Sinus (sinus maxillaris) zu beurtheilen." If we accept the above interpretation then the sinus-maxillaris *anlage* is established with the first evidences of the infundibulum ethmoidale. Zuckerkandl also, presumably, considers the infundibulum ethmoidale a part of the early sinus maxillaris. What he labels "S. m." (Sinus maxillaris), (Tafel XI, Figs. 5, 6, Normale und pathologische Anatomie der Nasenhöhle und ihrer pneumatischen Anhänge, Bd. I, Wien und Leipzig, 1893) is certainly in part infundibulum ethmoidale. We seldom see the primitive sinus maxillaris so far ventral as Zuckerkandl represents it to be in Fig. 6, Taf. XI, of the above named work. What he labels "S. m." in the latter figure is, I think, wholly infundibulum ethmoidale, *i. e.*, a frontal section of the superior and ventral portion of it. I, however, think that we should speak of the sinus maxillaris as developing from the pre-existing furrow (infundibulum ethmoidale), and not consider the latter a part of the sinus maxillaris. However, as stated before, it is difficult at times to draw this distinction; especially so when the primitive sinus maxillaris is extensive and occupies the greater portion of the infundibulum ethmoidale in its early pouching.

The duplication of the primitive maxillary pouch, and the extensive pouching that we occasionally have, is entirely in accord with adult conditions—in that the adult ostium maxillare varies from a small aperture to a long slit-like opening, while in other cases the ostium is duplicated. In this connection I may be permitted to quote briefly from an earlier paper: "I have found the primitive maxillary pouch duplicated. . . . This may explain some of the duplications of the ostium maxillare of the adult sinus. The two primary pouches may fuse distally, leaving the two points of evagination as the ostia maxillaria of the adult cavity. This embryonal condition in all probability explains some of the cases in which the sinus maxillaris is divided into two partly or wholly separate compartments by a vertical partition, *i. e.*, each pouch developing into an adult cavity independent of its mate . . . The great differences in the dimensions of the adult ostium may be due to the coalescence of two or more maxillary pouches; or the primitive pouching may have been single but extensive."

The early sinus maxillaris is for a time a slit-like cavity in the lateral wall of the nose. It extends inferiorly into the recess formed by the union of the cartilage of the lateral wall with that of the concha nasalis inferior (fig. 18). By resorption (of cartilage) and growth (of sac), the sinus ultimately breaks through the cartilage in the position mentioned above (figs. 31 and 34). Its further extension into the body of the maxilla is accomplished by the simultaneous growth of the sinus and the resorption of surrounding bone, this taking place *pari passu* with the growth of the face.

For a further consideration of the sinus maxillaris the reader is referred to a previous paper by the writer bearing directly upon this cavity.

THE SINUS FRONTALIS.

The point from which the sinus frontalis develops is somewhat variable. Like the sinus maxillaris it develops from a preformed cavity or space. In a previous paragraph mention was made of the frontal recess, and of the folds and furrows which configure its lateral wall. The recess and the furrows especially concern us in connection with the development of the sinus frontalis. It will be recalled that the number of furrows is variable, and that the infundibulum ethmoidale bears inconstant relations to these furrows (figs. 38 to 43). At term, or even somewhat earlier, the furrows have already pouched at their superior ends towards the frontal region, thus forming early anterior ethmoidal cells. Frontal and horizontal sections will, therefore, if made at appropriate planes, show cross-sections of cavities instead of furrows (compare figs. 32, 36, and 44). The frontal recess is at this time also quite roomy and is more or less variable in its extent (figs. 36 and 41).

As Killian has properly pointed out, the frontal sinus may develop from one or more anterior ethmoid cells, from an ethmoid cell and the frontal recess, or by direct extension of the whole frontal recess. At birth it can hardly be said from what point the frontal sinus will ultimately develop into the adult cavity. According to my studies the frontal sinus may also in exceptional cases develop from the superior and ventral end of the infundibulum ethmoidale, *i. e.*, the infundibulum ethmoidale continuing its development superiorly and ventrally, lateral to the frontal recess and frontal furrows,

and then expanding into the sinus frontalis. In the vast majority of cases, however, the infundibulum ethmoidale has absolutely nothing to do with the development of the frontal sinus.

Does the embryology account for the varying adult relations of the nasofrontal duct and the sinus frontalis, with the structures in the ventral and superior portion of the meatus nasi medius? To this question I must give an affirmative

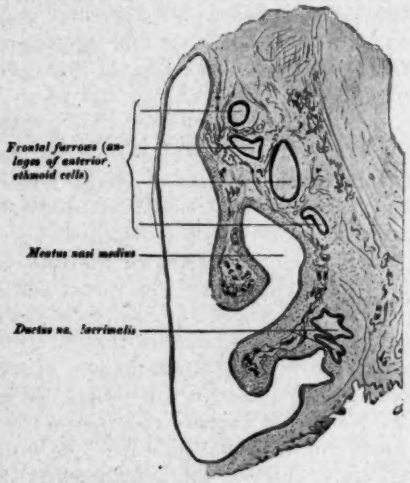


Fig. 44 (× 3.9) Drawing of a frontal section through the nose of a term fetus (series D, slide 4). The frontal furrows have pouched towards the frontal region and have established early anterior ethmoid cells. The frontal recess is obliterated by the coalescence of the frontal folds with the lateral surface of the concha nasalis media —compare with fig. 36 B.

answer, because I think that careful analyses of this region in a series of adult specimens justify our embryologic conclusions.

It will doubtless aid in making the adult conditions one meets more comprehensible if we here refer to specific fetal conditions. In fig. 41 the infundibulum ethmoidale is in line with the third frontal furrow, but not directly continuous with it. If in this case the frontal sinus should develop from the

anterior ethmoid cell of the first or second frontal furrows, or from the frontal recess directly, the nasofrontal duct of the adult sinus would doubtless communicate directly with the meatus nasi medius and not with the infundibulum ethmoidale. If, on the other hand, the frontal sinus should develop from the cell of the third frontal furrow, the nasofrontal duct would practically be continued down to the infundibulum ethmoidale, but not *directly* continuous with it, *unless the bridge of intervening tissue were resorbed* as it frequently is. A frontal sinus developing from the cell of the third frontal furrow would in all probability have a tortuous nasofrontal duct, this of course depending largely on the disposition and size of the other anterior ethmoid cells.

In the specimen shown in fig. 38 the infundibulum ethmoidale and the first frontal furrow are practically continuous with each other. Should the frontal sinus develop from the first frontal furrow in such a condition, the nasofrontal duct would of course be directly continuous with the infundibulum ethmoidale in the adult. We can not say, however, that in such a condition, the sinus frontalis develops from the infundibulum ethmoidale. From adult relations it would appear as if the latter interpretation were correct; embryology, however, shows the error of this contention. If in the specimen shown in fig. 41 the frontal sinus formation should take place from the cell of the second frontal furrow, the nasofrontal duct would be continued down to the infundibulum ethmoidale at an angle, but not be directly continuous with it. In the specimen shown in fig. 43 (from a child aged 14 months) we find the whole frontal recess extending and developing into the frontal sinus. In the latter case the adult sinus would in all probability have no true nasofrontal duct, but the sinus would open directly into the ventral and superior portion of the meatus nasi medius.

Note the possibilities of adult relations in the fetal specimens shown in figs. 39 and 40. In the specimen shown in fig. 41 the infundibulum ethmoidale might continue its development or pouching lateral to the frontal recess and frontal furrows and thus form the frontal sinus. The aforementioned conditions are met with in the adult nose, and all may be accounted for by studying the varying fetal condition. In a general way we may say that, when the frontal sinus develops from

an anterior ethmoid cell, the adult sinus will have a nasofrontal duct—the tortuosity of the duct depending upon the cell from which the sinus developed and upon the degree of development and the disposition of the other anterior ethmoid cells. On the other hand, when the frontal sinus develops by a direct extension of the frontal recess there will in all likelihood be no true nasofrontal duct. Occasionally the adult frontal sinus has two nasofrontal ducts. This is explained by the fact that the sinus at times develops from two anterior ethmoid cells. In many instances the frontal sinus is in reality nothing other than an extensively developed anterior ethmoid cell.

THE CELLULAE ETHMOIDALES.

The ethmoidal cells all develop from preformed furrows or recesses. They are nothing but extensions from some of the meatus nasi directly, or from the accessory recesses and furrows of the meatus nasi medius and superior. From the frontal furrows of the recessus frontalis, and from the furrows of the descending ramus of the meatus medius, the anterior group of ethmoid cells develop. From the ventral and superior extremity, and the superior and inferior recesses of the meatus superior; and the meatus suprema I, the posterior group of ethmoid cells develop. The anterior group have, therefore, their ostia opening inferior to the attached border of the concha nasalis media, and the posterior group have their ostia opening superior to it. The so-called middle group of ethmoidal cells are thus classed with the anterior group, and the term "middle ethmoidal cells" is dropped. This I think is a better classification because the cells of the bulla are closely associated with the cells of the frontal recess.

The lateral masses of the ethmoid bone and its appendages, such as major and accessory conchæ, are primitively solid structures. Later, however, the lateral masses become more or less honey-combed or labyrinth-like by the developing ethmoidal cells. The ethmoid cells, while primarily confined to the lateral ethmoidal masses, frequently extend beyond these limits into the concha media, the processus uncinatus, and the agger nasi. The bulla ethmoidalis is practically always shell-like, due to a cell or cells. Anterior ethmoid cells may develop far into the frontal region, and in many cases might be classed as frontal sinuses. In some adult specimens

in which two large sinuses are present on the same side of the frontal region, it is difficult to say whether they are both frontal sinuses or extensively developed anterior ethmoidal cells. Developmentally, in many cases, they are ethmoid cells, and topographically they should be classed as frontal sinuses. Occasionally the posterior ethmoid cell which develops from the meatus nasi suprema I extends into the sphenoidal sinus. The superior and the supreme conchæ usually become more or less shell-like in the adult, due to the developing posterior ethmoid cells.

In the formation of the ethmoid labyrinth there is no uniformity. In a general way the anterior group of ethmoidal cells is ventral to the posterior group. There is, however, at times, considerable overlapping of the two groups. Each cell as it grows from a preformed furrow or recess tends more or less towards the cribriform plate of the ethmoid bone. Even though a certain cell has its anlage-point farther inferior than another cell, it may outgrow its neighbor and force the latter to progress in a direction other than to which it was primarily directed. Later the cells in the honeycombing of the lateral ethmoidal masses grow in almost any direction. Sometimes the intervening walls break down and larger single cavities are thus formed. Seydel very aptly says: " . . . die Zellen der verschiedenen Reihen stehen gewissermassen im Wettkampf mit einander, bald überwiegen die der einen, bald die der anderen Reihe. Daher verlaufen die Trennungslinien zwischen den Reihen keineswegs immer genau wie die Muschelursprünge."

THE SINUS SPHENOIDALIS.

Of the sinus sphenoidalis little need be said in this paper. It is primitively nothing but a constriction from the dorsal and superior portion of the nasal fossa, a fact already pointed out by Dursy. This constriction of the nasal fossa in the formation of the anlage of the sphenoidal sinus is evident fairly early, and at birth the sinus is comparatively well advanced in most instances.

Its further development depends, of course, just as in the other sinuses, upon the simultaneous growth of the sac and the resorption of bone. In this manner the sphenoidal cavity becomes well established in the body of the sphenoid bone.

In the frontal section shown in fig. 20 we have represented the manner of constriction of the superior and dorsal portions of the nasal fossæ in the formation of sphenoidal-sinus anlages. Later the sinuses are represented by very shallow pits and by the 5th month of extrauterine life the sinuses are well established (fig. 42).

V. Some Later Developmental Changes on the Lateral Wall as Presented in the Adult Nose.

It is not necessary to consider the adult lateral nasal wall in detail since the general anatomy is so well known, and besides the descriptions of the late fetal conditions as given, would in a measure be duplicated in a detailed description of the adult lateral wall. There are, however, certain conditions and relations of great importance which develop much later, and varying opinions are entertained on some of these points. We will, therefore, in subsequent paragraphs consider the later developmental changes with especial reference to: (1) the number of ethmoidal conchæ in the adult; (2) the ethmoid cells with especial reference to their ostia; (3) the ostia maxillaria; (4) the relations of the nasofrontal duct with especial reference to the manner of communication of the frontal sinus with the meatus nasi medius.

THE NUMBER OF ETHMOIDAL CONCHAE IN THE ADULT.

In previous paragraphs we dwelt at some length on the number of ethmoidal conchæ that are differentiated before birth. We found that the number varied from three to five; with four major conchal folds in the ethmoidal region rather common, and five not at all unusual. The concha suprema III early loses its identity in the vast majority of cases. This is also true of the concha suprema II; however it is as a rule somewhat farther delayed. The question naturally arises: how far does the reduction in ethmoidal conchæ progress? and what is the average number of conchæ in the adult in a large series of specimens?

Naturally in the cases where the meatus suprema I is very shallow and short, it becomes a personal equation as to whether the shallow furrow should be considered as a meatus or merely as a groove on the medial surface of the concha superior. In

one case it means an extra concha; in the other the whole ethmoidal mass, superior to the concha media is considered as the concha superior. This is doubtless the reason why writers differ so widely in their results. Again, the accessory concha in the meatus superior, when well developed, is at times erroneously considered as the concha superior. This, of course, leads to divergent results as to the number of ethmoidal conchæ that are present in the adult nose.

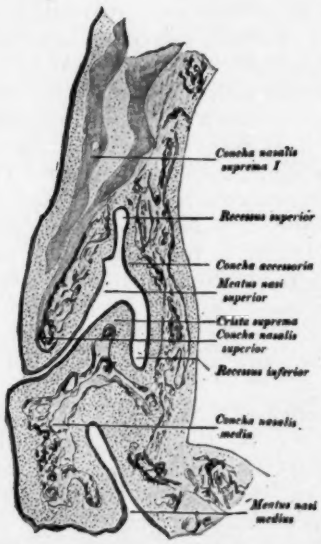


Fig. 45 (× 10) Drawing of a frontal section through the lateral wall of the nasal cavity of a 7-months fetus (series C, slide 8). The section is in the region of the accessory concha of the superior meatus. It shows the well developed "crista suprema" of the concha media, also the marked curling of the latter concha.

Zuckerkandl in "120 Kopfhälften" of adults found two ethmoidal conchæ in 24 of them, and three ethmoidal conchæ in 96 of them. In this number he found his "mittlere Siebbeinmuschel operkulisiert" in 11 instances. According to some of his figures he has at times considered my accessory concha of the meatus superior as his "mittlere Siebbeinmuschel." If we subtract 11 cases from the 96 and add them to the 24, we would

presumably have a better ratio for comparison with other results. The accessory concha of the meatus superior is very prominent in some adult noses, and a large number of specimens show at least a rudimentary accessory concha.

The fourth annual report of the committee of collective investigation of the Anatomical Society of Great Britain and Ireland, gives the following results: Out of 152 observations, 3 cases are reported with but one ethmoidal concha; 85 cases with two ethmoidal conchæ; 62 cases with three ethmoidal conchae; and 2 cases with four ethmoidal conchæ. This report is the result of fifteen subreports from as many different schools, with presumably a larger number of observers. It is, therefore, difficult in such a report to have uniformity in observation because, as stated before, the personal equation as to what should be considered a concha in the cases where the differentiation is slight, is obviously great. The report shows that in a few instances the reduction in ethmoidal conchæ has progressed but little. The number of times that three ethmoidal conchæ are present in the adult nose is rather low in the above report, as compared with the statements of other observers. Unless one continually remember the late fetal conditions, he is apt, in many cases, not to recognize the concha suprema I in the adult nose, *i. e.*, when the concha is very rudimentary.

I recently examined 120 adult lateral nasal walls, with especial reference to the number of major ethmoidal conchæ. I found that 75 specimens presented three ethmoidal conchæ, and the remaining 45 specimens but two ethmoidal conchae. A few of the specimens were suggestive of having four ethmoidal conchæ. I find that the ostium of the ethmoidal cell which develops from the meatus suprema I is very often a good point for orientation in determining the presence of a concha suprema I (adult).

According to Zuckerkandl's series and the series I examined, we should consider the adult ethmoidal region as usually presenting three ethmoidal conchæ rather than two.

THE ETHMOID CELLS AND THEIR OSTIA.

In a previous paragraph on the anlages of the ethmoidal cells we divided them into two groups—anterior and posterior. All those cells that have their ostia opening inferior to the at-

tached border of the concha nasalis media may be designated as anterior ethmoidal cells; and those that have their ostia opening superior to the attached border of the concha nasalis media may be designated as posterior ethmoidal cells. The anterior group are in a general way ventral to the posterior group; however there is at times considerable overlapping of the two groups.

The posterior group of cells. The posterior group of cells communicate with the meatus nasi superior and suprema I. The latter meatus is present, according to my specimens, in 62.5 per cent of cases; and 75 per cent of the positive specimens have a posterior ethmoid cell opening into this meatus. In some instances the cell which opens into the meatus suprema I is very large and it may encroach upon the lumen of the sphenoidal sinus. Rarely two posterior ethmoidal cells communicate with the meatus suprema I.

It is a constant condition to have posterior cells opening into the superior meatus. According to my specimens we invariably have a posterior ethmoid cell opening at the superior and ventral extremity of the superior meatus. The latter cell very frequently extends into the body of the concha media, and at times is excessively large. In previous paragraphs we spoke of an accessory concha of the superior meatus. We will recall the presence of recesses, inferior and superior to the latter concha—these recesses early giving evidence of cell-anlages. If we carefully look over a series of adult specimens we will in many cases see evidences of this accessory concha, which at times is well formed. Since the fetus gave evidence of developing cells from the two recesses mentioned we would in the adult expect to find ostia of posterior ethmoidal cells in these positions. Twenty-six per cent of my specimens showed a posterior cell opening in the position of the superior recess, and in 50 per cent of cases a posterior cell opened in the position of the inferior recess.

To recapitulate: The posterior ethmoidal cells open into the meatus nasi superior and suprema I. The latter meatus is present in 62.5 per cent of adult cases, and in 75 per cent of instances this meatus has a posterior ethmoidal cell communicating with it. The superior meatus has in 100 per cent of cases a cell communicating with it at its ventral and superior termination. The superior meatus has also in 26 per cent of

instances a cell opening into the superior recess, and in 50 per cent of cases a cell opening into the inferior recess.

These adult conditions justify our conclusions with reference to cell-anlages in the fetus and young child.

The anterior group of cells. It will be recalled that we referred to anlages of anterior ethmoidal cells in both the ascending and descending rami of the meatus nasi medius, *i. e.*, in the regions of the bullar furrows and the frontal recess. If now we examine a series of adult specimens we will notice in the positions of the former cell-anlages that we now have ostia of cells. My series of specimens indicate that in 100 per cent of cases anterior ethmoid cells have their ostia in the position of the suprabullar recess or furrow. The cells that open in this position vary in number from one to three. They are directed variously behind the bulla ethmoidalis, thus causing the latter structure to be hollowed out and shell-like and at times excessively large. Some of the cells with their ostia in the position of the suprabullar recess may also be directed towards the cribriform plate or towards the frontal sinus. I find in 13 per cent of instances that there is an ostium on the medial surface of the bulla ethmoidalis, or in the position of the original bullar furrow (fig. 31). In 11 per cent of cases an ostium is found in the position of the infrabullar furrow. The cells that communicate with the middle meatus in the location of the latter two places are usually very small.

The anterior ethmoidal cells that develop in the region of the ascending limb of the middle meatus, *i. e.*, in the region of the frontal recess, are very variable in size and position. The number of adult cells depends largely upon the degree of differentiation of frontal furrows in the fetus. Some of the cells in this position open directly into the middle meatus, others into the superior and ventral extremity of the infundibulum ethmoidale. Some also open into the suprabullar recess. Some of these anterior ethmoidal cells may extend towards the frontal sinus so that it is difficult to say whether the cavity is that of a frontal sinus or that of an anterior ethmoidal cell. The ventral and superior end of the infundibulum ethmoidale also frequently expands into an anterior ethmoidal cell, which at times is large.

THE CONCHAL AIR CELLS.

As was stated in a previous paragraph there is no uniformity in the development and arrangement of the cells of the ethmoid labyrinth. It will be recalled that the cells develop from preformed furrows, and that the former gradually extend into the lateral masses of the ethmoid bone. In this manner the lateral ethmoidal masses which were primitively solid structures become more or less labyrinth-like as age advances. The individual cells are usually separated by thin osseous plates, or as in some adult cases, merely by mucous membrane —the bony partition having been resorbed. Again the intervening walls may be entirely gone and one or the other group of cells may be replaced by a large cavity. Many of the ethmoid cells are completed by the articulation of the ethmoid with neighboring bones.

These cells in many cases are not confined to the limits of the lateral ethmoidal masses. They hollow out the superior and supreme ethmoidal conchæ so that in the adult these conchæ are merely thin shell-like medial boundaries of posterior ethmoidal cells. The cells also at times extend into the sphenoidal sinuses, and also encroach upon the lumina of the frontal sinuses. Should the intervening walls break down we would have established a communication between either of the sinuses and certain of the ethmoidal cells. Ethmoid cells very frequently extend into the ventral extremity of the concha media, into the ventral extremity of the processus uncinatus, and into the agger nasi. The bulla ethmoidalis is almost invariably shell-like because of air cells. At times the concha nasalis media contains multiple air cells or it may contain a very large single cell which causes the concha to look bleb-like. It is very common for the posterior ethmoid cell which develops from the ventral and superior extremity of the meatus nasi superior to extend beyond the limits of the lateral ethmoidal mass into the concha media. Sometimes a cell develops from the so-called sinus of the concha media, which more or less hollows out the ventral extremity of the concha. Anterior ethmoidal cells may also extend into the concha media. The cells that extend into the agger nasi and processus uncinatus may communicate either with the meatus medius directly or with the superior and ventral extremity of the infundibulum ethmoidale. The concha nasalis media at times curls laterally and

superiorly and thus forms the so-called sinus of the middle concha. This curling is, however, not extensive as a rule and the area included by it always opens freely into the middle meatus. It is usually unimportant.

These conchal cells have led to conflicting and some erroneous theories as to their genesis. They surely are nothing other than ethmoidal cells which have developed beyond the limits of the lateral ethmoidal masses into the appendages of the masses, *i. e.*, into the conchæ. Occasionally a cell develops into the concha media which has its anlage-point on the lateral surface of this concha (figs. 34 and 35).

These conchal cells may become the seat of pathologic conditions, just as do other paranasal chambers, but the cells do not in any manner owe their origin to such conditions. For a further consideration on conchal cells the reader is referred to a previous paper by the writer bearing directly on these cells.

THE OSTIA MAXILLARIA.

In this connection little need be said about the ostium maxillare. In the adult it of course is in the position of the primitive sinus maxillaris, *i. e.*, the adult ostium corresponds in position to the evagination of the mucous membrane in the infundibulum ethmoidale for the formation of the anlage of the sinus maxillaris. The formation of the ostium maxillare was, therefore, considered in previous paragraphs and nothing further need be added here. While the ostium maxillare may be primitively double, *i. e.*, the anlage of the sinus maxillaris may be represented by a double pouching, it (the ostium) at times becomes duplicated later in life. This latter duplication of the ostium needs to be considered since certain later developmental processes are involved. Very frequently there is also an ostium present in the adult nose which communicates directly between the sinus maxillaris and the meatus nasi medius. This ostium is not present in the fetus and young child, hence a later developmental process is here involved. In order to complete the consideration of the various developmental stages of the lateral nasal wall it will be necessary briefly to consider the duplication of the ostium maxillare and the ostium maxillare accessorium.

The ostium maxillare accessorium. In a previous paper I referred to the frequent occurrence of an accessory aperture

of the sinus maxillaris. In the same article I dwelt briefly on the theories held by several writers as to the genesis of this opening, and stated that I hoped to study the accessory aperture more extensively in the fetus and child, to see whether the opening, after all, at times, did not have an embryologic significance. Since then I have had the opportunity of examining a larger number of specimens of the lateral nasal wall of the adult, child, and fetus.

This accessory ostium is, as a rule, situated in the membranous portion of the lateral wall of the middle meatus, a short distance above the cephalic and attached border of the inferior nasal concha, at about the junction of its middle and posterior thirds. In some instances the accessory ostium is found immediately dorsal to the infundibulum ethmoidale—occasionally actually extending into the latter. This accessory ostium is usually single but occasionally it is duplicated, and rarely three accessory apertures are present in this portion of the middle meatus. The aperture must not be confused with the duplication of the ostium maxillare which is located in the depth of the infundibulum ethmoidale; however at times very near its dorsal extremity.

Nathaniel Highmore, who apparently was the first anatomist to describe the maxillary sinus, does not mention anything about this accessory ostium. J. Cruveilhier refers to an orifice in the middle meatus, apparently the accessory ostium of the sinus maxillaris, which he considers the "plus ordinairement *l'orifice du sinus maxillaire.*" Further he says that "Cet orifice semble manquer quelquefois; on le trouve alors au niveau de la partie moyenne de l'infundibulum; on dirait, dans ce cas, que le sinus maxillaire communique directement avec les sinus frontaux et non avec les fosses nasales." He also calls attention to the fact that the maxillary sinus may possess two apertures: "Il n'est pas rare de voir le sinus maxillaire communiquer a la fois et dans le méat moyen et dans l'infundibulum."

From the above we must conclude that Cruveilhier considered the accessory aperture as the more regular ostium of the sinus maxillaris, but recognized that it is inconstant. He erroneously thought that the ostium maxillare, which is constant and communicates with the infundibulum ethmoidale, was not always present, and when it was present, that the maxillary sinus communicated with the frontal sinus and not with the

middle meatus. We only rarely have direct communication between the frontal and maxillary sinuses (Cryer, Brophy, and J. P. Schaeffer have reported such cases). While from a practical point of view the frontal sinus communicates with the maxillary sinus in many cases, due to the infundibulum ethmoidale acting as a gutter between the frontal region and the ostium maxillare, we have no right to say that the two sinuses are in communication with each other directly. In all cases the sinus maxillaris communicates indirectly with the meatus medius by way of the hiatus semilunaris. Gosselin, however, recognized that the sinus maxillaris constantly communicated with the "Trichter" (infundibulum ethmoidale). Henle figures an accessory opening of the sinus maxillaris under the name "unbeständige Communicationsöffnung."

Giraldès in 100 cadavers found this accessory ostium "acht bis zehn Mal." Zuckerkandl reports it present "in jedem neunten bis zehnten Falle." Chiari and Hajek found an accessory ostium in every fifth case. Turner found it four times in nine dissections. In a former paper I reported an accessory maxillary ostium present thirty-five times out of 80 specimens examined, or a percentage of 43.75. Three of the specimens presented two accessory ostia, or a percentage of 3.75.

Since the publication of the aforementioned paper my attention was directed to a report (Fourth annual report of the committee of collective investigation of the Anatomical Society of Great Britain and Ireland) which was inadvertently overlooked before. This report covers the examination of 152 specimens. In this number of specimens it was found that 53 per cent of maxillary sinuses possessed but one aperture (presumably the ostium maxillare); 44.1 per cent, two apertures (presumably the regular ostium, and either the duplication of the latter or the ostium accessorium); and 2.9 per cent, three apertures (presumably two accessory ostia besides the regular aperture). The sinus maxillaris communicated with the infundibulum ethmoidale by two apertures (a duplication of the regular ostium) in 17.6 per cent of cases. In this report no mention is made as to what is considered a duplication of the normal aperture. In some cases an accessory ostium is placed immediately dorsal to the infundibulum ethmoidale, in fact is very often continuous with the infundibulum. I imagine that some of the latter cases are included among the 17.6 per cent

of specimens. Unless the opening were wholly included within the dorsal end of the infundibulum I considered the aperture as an accessory ostium, communicating directly between the sinus maxillaris and the meatus nasi medius, and not as a duplication of the ostium maxillare proper. With this fact kept in mind the above report agrees closely with the figures in my former paper and also with the results obtained in the following series.

I recently examined 125 adult specimens (including those of my former series) of the lateral nasal wall and found that 53 of them had accessory ostia communicating directly between the maxillary sinus and the middle meatus—a percentage of 42.4. Three of the specimens presented two such openings—a percentage of 2.4.

J. A. Giraldès was apparently the first to consider this opening from a developmental point of view. He came to the conclusion "dass in allen Fällen, wo diese abnorme Oeffnung besteht, sie immer das Product eines pathologischen Vorganges und durch eine wirkliche Perforation zu Stande gekommen ist." He, however, considered this aperture much less common than it is, thinking it present in only 8 or 10 per cent of instances. Giraldès bases his pathologic theory on the fact that he had the privilege of following the "Entwicklungsphasen von der Verdünnung der Schleimhaut des Ganges bis zur volständingen Durchbohrung." Zuckerkandl corroborates the thinning of the mucous membrane, but does not hold to the pathologic theory. The latter author has seen some cases where an accessory aperture was caused by the gradual wearing of a "zugespitzer Hakenfortsatz der Nasenscheidewand," which finally resulted in an opening on the lateral wall of the middle meatus.

While some accessory apertures are obviously due to a pathologic process as suggested by Giraldès, and others are caused in a mechanical manner by spurs on the nasal septum, as suggested by Zuckerkandl, we certainly must look elsewhere in the vast majority of cases to find the genesis of this very common aperture.

I agree that there is a thinning of the mucous membrane in the position of the accessory ostium, but believe that the explanation for this is found in the development of the sinus maxillaris. In infancy the walls of the sinus maxillaris are comparatively very thick. We know that the sinus cavity in-

creases by the simultaneous growth of the sac and the resorption of surrounding tissue, these processes taking place *pari passu* with the growth of the face. In this manner the sinus walls become thinner, up to a limit, as age advances. The thinning out apparently progresses unevenly, as evidenced by the very uneven walls of many adult cavities. On the base or medial wall of the cavity we have an area that is in time composed of merely two layers of abutting mucous membrane, one the mucous membrane of the middle meatus, and the other the mucous membrane of the maxillary sinus. These two layers of mucous membrane with no intervening bone offers very little resistance to the growing maxillary cavity. In time they become so thinned out and attenuated in many instances that ultimately an opening is formed, thus establishing the ostium maxillare accessorium. This reminds one of the early thinning and attenuation and ultimate rupture of the two layers of abutting epithelium—the bucconasal membranes—in the establishment of the primitive choanæ.

If we accept this view, and to me it seems plausible, as to the genesis of the ostium maxillare accessorium, we would not expect to find the ostium in fetuses nor in young children. We would neither expect to find often this accessory aperture in the young adult, *i. e.*, before the twentieth year of age. We would, however, especially look for it in the more advanced adult, after the walls of the sinus maxillaris have been thinned out by the large adult cavity. This is in accord with my results. I have never been able to find the ostium maxillare accessorium in the fetus nor in the child. It occurs, as far as my observations would indicate, only in the adult. I have found it in adults between the ages of twenty and ninety years. It is a very frequent aperture from thirty-five years on. Symington likewise never found the accessory ostium in children. He says: "In children I have never found more than one aperture, viz., that into the infundibulum."

I have, therefore, come to the conclusion that the ostium maxillare accessorium is in most instances established by the developing sinus maxillaris. The growth of the sinus causes the two layers of abutting mucous membrane to become thinned out and attenuated, ultimately resulting in an opening in very many adult noses. Some are doubtless due to a pathologic process, and others produced in a mechanical manner by septal

spurs. Enlarged middle conchæ may also wear holes into the maxillary sinus in this position; this is, however, rare.

The duplication of the ostium maxillare. In a previous paragraph I spoke of the double pouching of the primitive maxillary sinus. By the distal fusion of the two pouches the points of evagination would remain as the adult ostia maxillaria, yet the adult cavity would be single. Other duplications

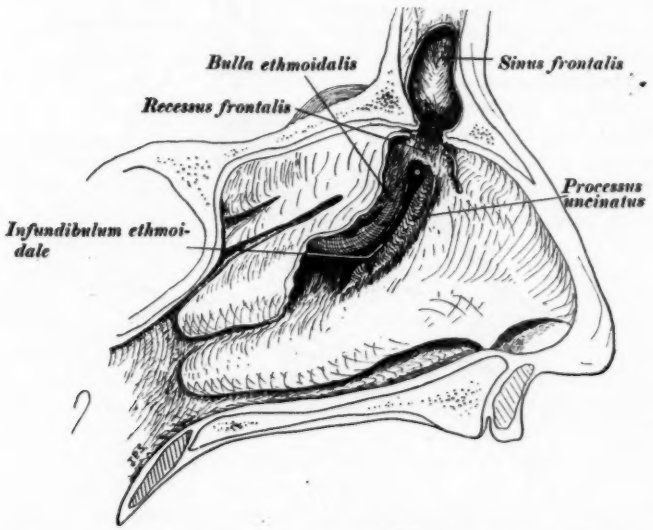


Fig. 46 A semidiagrammatic drawing of an adult lateral nasal wall. The concha nasalis media is represented as partly cut away so as to expose the underlying structures. Note the nasofrontal relations, and that there is no true nasofrontal duct. The frontal sinus presumably developed by an extension of the frontal recess directly. Compare this with the conditions represented in figs. 47, 48 and 49.

of the regular maxillary ostium are doubtless caused in a manner similar to the establishment of the ostium accessorium, i. e., by the attenuation and ultimate rupture of the mucous membrane in this position. The same conditions prevail here as in the position of the ostium accessorium, since it is in the immediate neighborhood.

THE COMMUNICATION OF THE FRONTAL SINUS WITH THE MIDDLE MEATUS.

We previously considered the early conditions of the frontal recess with especial reference to the frontal furrows found on its lateral wall. Reference was made to the possible points of origin of the sinus frontalis. It now remains briefly to con-

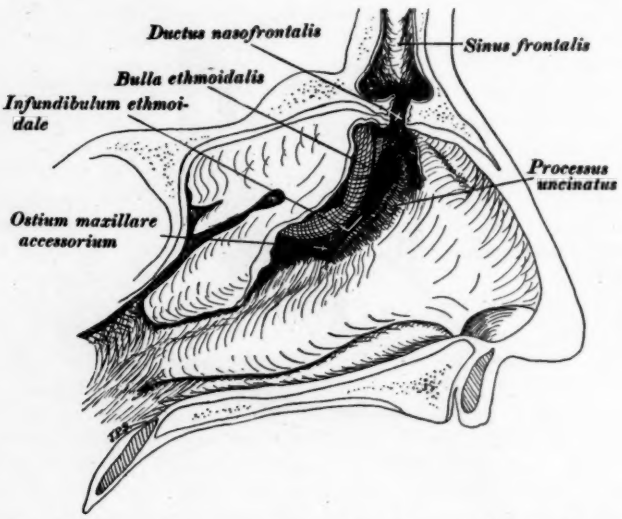


Fig. 47 A semidiagrammatic drawing of an adult lateral nasal wall. The concha nasalis media is represented as partly cut away. Compare the nasofrontal relations with those found in fig. 46. In this case there is a nasofrontal duct which meets the infundibulum ethmoidale at an angle. Some of the secretion from the frontal sinus would find its way directly into the meatus medius, and the remainder would pass into the superior and ventral portion of the infundibulum ethmoidale. The frontal sinus in this case presumably developed from an anterior ethmoid cell.

sider the ventral and superior portion of the meatus medius with especial reference to the manner of communication of the frontal sinus with the middle meatus in the adult, to see whether our earlier conclusions on this portion of the lateral nasal wall were justifiable. We previously concluded that the frontal sinus might develop from the frontal recess directly;

from one or more anterior ethmoid cells which developed from the frontal furrows; from the recess and a cell; or rarely by direct extension of the superior and ventral extremity of the infundibulum ethmoidale. In figs. 46 to 49 we have semi-diagrammatic representations of prevailing adult types of nasofrontal relations.

In fig. 46 the frontal sinus is continued down to the frontal recess, that is, to the ventral and superior portion of the meatus medius. In such a case there is no true nasofrontal duct and presumably the frontal sinus developed by a direct extension of the frontal recess. Note that the infundibulum ethmoidale ends in an air cell and that it is not continuous with the frontal sinus. Occasionally in these instances the infundibulum ethmoidale is carried much nearer to the frontal sinus, and secretion from the latter may drain almost directly into the ventral and superior portion of the infundibulum.

In fig. 47 there is a nasofrontal duct. This represents a very common condition. Note that while the infundibulum ethmoidale is not continuous with the nasofrontal duct it nevertheless meets the latter duct at an angle. Secretions from the frontal sinus would drain partly into the infundibulum ethmoidale and partly into the middle meatus directly. Doubtless the frontal sinus in such instances developed by the extension of an anterior ethmoidal cell that had its origin in one of the frontal furrows.

In fig. 48 we again have the representation of a prevailing condition or type. There is again a nasofrontal duct, but it is not in line with the infundibulum ethmoidale. Practically all secretion from the frontal sinus would drain into the meatus nasi medius. We must here conclude that the frontal sinus developed by an extension of an anterior ethmoidal cell, presumably the cell from the first frontal furrow.

In fig. 49 the infundibulum ethmoidale is continuous with the nasofrontal duct. There are two possibilities of development for the frontal sinus in these cases. In the first place the infundibulum ethmoidale may have continued its development superiorly and ventrally, lateral to the frontal furrows, and then enlarged into the frontal sinus. Another explanation may be found in the fact that the infundibulum ethmoidale may have been continuous with a frontal furrow; if not continuous, the intervening lamella of tissue may have been re-

sorbed and the two channels thus made continuous. *It is not common for the infundibulum ethmoidale to be* DIRECTLY *continuous with the nasofrontal duct.* At first sight it may appear so, but careful dissection will show that, in the majority of cases where intimate relations exist between the infundibulum ethmoidale and the nasofrontal duct, *the two channels meet each other at varying angles.* At times there is actually a

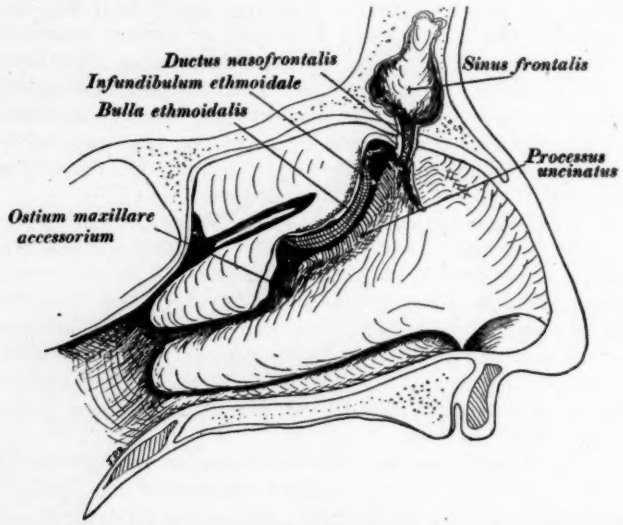


Fig. 48. A semidiagrammatic drawing of an adult lateral nasal wall. The concha media is again represented as partly cut away so as to expose the operculated structures. Compare the nasofrontal relations with those represented in figs. 46 and 47. Practically all of the secretion from the frontal sinus would drain directly into the meatus nasi medius. The frontal sinus is doubtless an extension of an anterior ethmoidal cell.

slight groove connecting the two channels. We have, however, no right to say that in such cases, the nasofrontal duct is directly continuous with the ventral and superior end of the infundibulum ethmoidale.

In fig. 50 anterior ethmoidal cells from two frontal furrows are developed sufficiently to be called frontal sinuses. Both communicate with the frontal recess or the ventral and superior

portion of the meatus medius. In such instances the intervening wall may break down and an adult frontal sinus with two nasofrontal ducts will be present. Occasionally we find a frontal sinus with two ducts leading from it, and the above explanation for such a condition seems plausible.

If we take all the cases that fall under the types as represented by figs. 47 and 49, they will include about 56 per cent of my specimens; type, fig. 47, being the much more common of

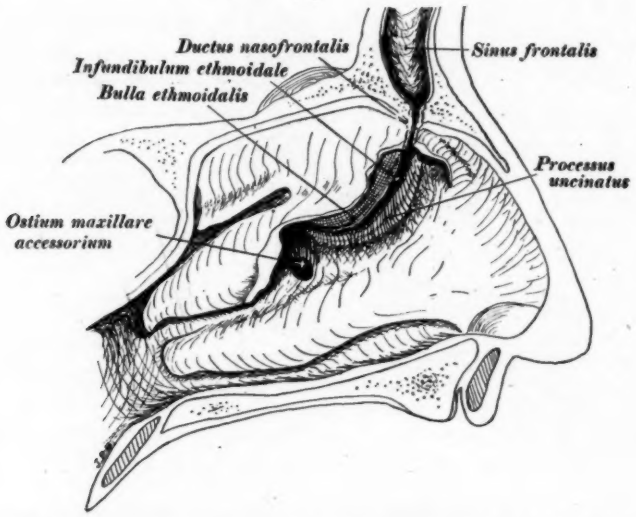


Fig. 49 A semidiagrammatic drawing of an adult lateral nasal wall. The concha nasalis media is partly cut away. The infundibulum ethmoidale is directly continuous with the nasofrontal duct—a condition not common.

the two. In a previous paper these two types were included among the specimens as representing positive fronto-maxillary relations. The specimens falling under the type as represented by fig. 46 will also frequently fall under the above classification. The specimens falling under the type as is represented by fig. 48 will include approximately 40 per cent of my adult specimens. The latter were in a previous paper included among the specimens as representing negative fronto-maxil-

lary relations. Specimens will, of course, now and then differ somewhat from these types, but they will all in a general way fall under one or the other group.

In this manner we can account for two frontal sinuses on one side. We can also account for the so-called absence of a frontal sinus. Should the frontal recess or an anterior ethmoidal cell of a frontal furrow, stop short of the vertical por-

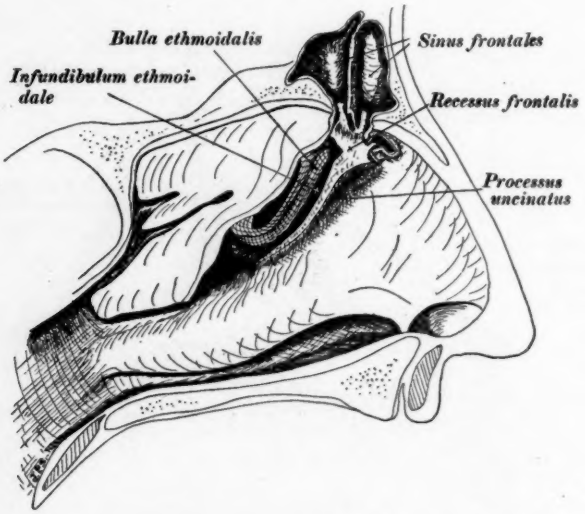


Fig. 50 A semidiagrammatic drawing of an adult lateral nasal wall. The concha media is partly cut away so as to expose for study the underlying parts. It gives evidence of three primitive frontal furrows, viz., two frontal sinuses which doubtless developed from anterior ethmoid cells, and a third cell which extends towards the agger nasi. The region of the frontal recess is well shown in the drawing.

tion of the frontal bone we would of course have a diminutive frontal sinus—in fact no frontal sinus as far as position is concerned. We must, however, remember that the first evidences of the frontal sinus must not be sought in the vertical portion of the frontal bone but in the superior and ventral portion of the meatus medius, *i. e.*, in the frontal recess. The developing frontal sinus may not progress farther than the

horizontal portion of the frontal bone. The different views held on the presence and absence of the frontal sinus is doubtless due to differences of opinion as to what should be called a frontal sinus, and how far the development must progress towards the frontal region before the cell has reached the dignity of a frontal sinus.

VI. Summary.

1. The nasal anlage establishes itself about the third week of embryonal life as localized thickenings of the ectoderm, located on both sides of the outer surface of the wall of the fore-brain, immediately superior to the primitive oral fossa.

2. During the fourth week the nasal areas become passively depressed, due to an increase in the thickness of the surrounding mesenchyme. In this manner the nasal pits become formed.

3. For some time the nasal pits communicate freely with the primitive oral fossa. The maxillary and the lateral nasal processes abut and fuse with the medial nasal processes, thus separating the nasal pits from the oral fossa.

4. For some time the lines of fusion of the maxillary and the lateral nasal processes with the medial nasal processes are represented by strands of ectodermal tissue. These ectodermal fusion-lines soon disappear ventrally and are replaced by mesenchyme; *i. e.*, the mesenchymal tissue of the maxillary and lateral nasal processes becomes continuous with that of the medial nasal processes.

5. Farther dorsally the ectodermal tissue between the fused maxillary and medial nasal processes does not wholly disappear, but strands of ectodermal tissue remain at the points of fusion. This ectodermal tissue thins out and ultimately ruptures, thus establishing the primitive choanæ.

6. The nasal pits deepen dorsally and superiorly, and in a 35-day embryo the olfactory organ is represented by two blindly ending pouches lying in the mesenchymal tissue above the oral cavity. These blind pouches may be termed the primitive nasal fossæ.

7. The dorsal extension of the blind primitive nasal fossæ continues until the ectoderm of the nasal fossæ meets the ectoderm of the oral cavity. We have now in these positions merely thin membranes composed of two layers of abutting

epithelium—nasal and oral—separating the dorsal portions of the primitive nasal fossæ from the oral cavity.

8. These membranes—the membranæ bucconasales—become attenuated and thinned out, ultimately resulting in rupture. In this manner the primitive choanæ are established, and again a communication between the nasal fossæ and the oral cavity. The primitive choanæ are established approximately from the 35th to the 38th day of embryonal life.

9. When first formed the nares communicate freely with the exterior, but shortly afterwards, in many cases, they become plugged by an overgrowth of epithelium. This plugging may be complete or more or less fenestrated in character.

10. With the formation of the primitive choanæ we have also established the primitive palate, *i. e.*, the portion of the roof of the primitive oral cavity extending from the primitive choanæ to the nares.

11. The palatal processes by fusing along their opposed edges in the median plane establish the definitive palate. In the formation of the definitive palate the nasal fossæ appropriate a considerable portion of the primitive oral cavity.

12. The nasal cavity which is early divided anteriorly by the medial nasal processes, becomes divided into fossæ farther dorsally by the growth and fusion of the nasal septum with the mid-palate line. This division of the nasal cavity into fossæ takes place from before backwards.

13. Coincidently with the formation of the definitive palate the primitive choanæ elongate and ultimately come to occupy the position of, and thus become, the permanent choanæ.

14. The lateral nasal wall is at first extremely simple, and it presents no evidence of its later complexity.

15. The first change on the lateral nasal wall from a more or less even surface is the production of very shallow grooves. The latter appearing inferior and superior to the position of the primitive concha nasalis inferior (maxillary fold). These shallow grooves at once throw into slight relief the greater portion of the lateral nasal wall—the anlage of the concha nasalis inferior.

16. Shortly after the first a second fold appears, outlining the anlage of the ethmoidal conchæ.

17. From three to five ethmoidal conchæ become differentiated before birth.

18. The ethmoidal conchæ in a general way present ascending and descending crura. The ascending crura are, however, in many cases not well differentiated. At times the ascending crura are represented by a general ascending-crural mass, but individual ascending crura are not outlined.

19. The ethmoidal meatuses, including the meatus nasi medius, also in a general way present ascending and descending rami. The descending rami are, however, by far the most marked. In fact many ethmoidal meatuses have no ascending rami. The ascending ramus of the meatus medius is the best outlined. Occasionally the meatus superior possesses a well marked ascending ramus.

20. The integrity of the ethmoidal conchæ and meatuses depends upon the descending limbs rather than upon the ascending limbs.

21. The ascending and the descending rami of the meatus medius present accessory conchæ and furrows which are comparable to structures found in other mammals.

22. The descending ramus of the meatus superior also presents an accessory concha on its lateral wall. It is at times well marked, and again it may be very rudimentary or be entirely wanting.

23. In the region of the knees or bends of the ethmoidal conchæ we frequently find lobules, and on these lobules secondary nodules are occasionally seen.

24. The descending ramus of the concha nasalis media very frequently presents furrows on its medial surface. One of these furrows at times more or less divides the concha into superior and inferior portions.

25. The sinus paranasales all develop from preformed furrows or pits, with the single exception of the sinus sphenoidalis which is primitively nothing but a constriction from the dorsal and superior portion of the nasal fossa.

26. The sinus maxillaris develops by an evagination from the infundibulum ethmoidale. The primitive sinus may be duplicated, in that the pouching is occasionally double. The primitive pouching is at times extensive, including a goodly portion of the infundibulum ethmoidale. These facts doubtless account for the very large ostium maxillare of some adults and the duplication of the ostium maxillare in some cases.

27. The sinus frontalis may develop either from the frontal

recess or from an anterior ethmoidal cell. It may also have a double origin, *i. e.*, from two anterior ethmoidal cells, or from an ethmoidal cell and the frontal recess. Rarely it develops by a direct extension of the infundibulum ethmoidale.

28. The anterior group of ethmoidal cells develop from the frontal furrows of the ascending ramus of the middle meatus, and from the furrows found on the lateral wall of the descending ramus of the middle meatus. The infundibulum ethmoidale at its superior and ventral termination very frequently dilates into an anterior ethmoidal cell.

29. The posterior group of ethmoidal cells develop from the superior and ventral end of the superior meatus, from the superior and inferior recesses of the superior meatus, and from the meatus suprema I. The latter meatus persists in about 62.5 per cent of cases.

30. We should consider the adult ethmoidal region as usually presenting three conchæ rather than two.

31. In the adult the posterior ethmoidal cells open into the meatus nasi superior and suprema I. The latter meatus is present in 62.5 per cent of my adult specimens, and in 75 per cent of instances this meatus has a posterior ethmoidal cell communicating with it. The superior meatus has in 100 per cent of cases a posterior ethmoid cell communicating with it at its ventral and superior termination. The superior meatus has also in 26 per cent of instances a cell opening into the superior recess, and in 50 per cent of cases a cell opening into the inferior recess.

32. In the adult the anterior ethmoid cells open into the meatus medius. According to my series of specimens, in 100 per cent of instances anterior ethmoid cells have their ostia in the position of the suprabullar recess or furrow. The cells that open in this position vary in number from one to three, and are directed variously behind the bulla ethmoidalis. They may also be directed towards the cribriform plate or towards the frontal sinus. I find that in 13 per cent of cases there is an ostium of an anterior ethmoid cell on the medial surface of the bulla ethmoidalis, or in the position of the original bullar furrow. In 11 per cent of instances an ostium of an anterior ethmoid cell is found in the position of the infrabullar furrow. The anterior ethmoid cells that develop from the frontal furrows vary in size, number and position. These cells may open

directly into the middle meatus or into the superior ventral end of the infundibulum ethmoidale. Some of them also frequently open into the suprabullar recess.

33. Ethmoid cells frequently extend into the body of the concha nasalis media, the agger nasi, and the processus uncinatus. These cells also at times encroach upon the cavities of the frontal and sphenoidal sinuses.

34. The ostium of the adult sinus maxillaris is frequently duplicated. This may be due to a double pouching of the primitive sinus maxillaris, or it may be developed later in a manner similar to the formation of the ostium maxillare accessorium.

35. The sinus maxillaris has, according to my series of specimens, an accessory ostium communicating with the meatus medius directly in 42.4 per cent of cases. I believe that this accessory ostium is formed by the developing sinus maxillaris, *i. e.*, the sinus maxillaris developing until the medial wall of the cavity becomes thinned out and attenuated in the position of the accessory opening, until an ostium is formed. The accessory ostium is not present in the fetus nor in the young child.

36. In the adult the sinus frontalis may communicate with the meatus nasi medius in one of the following ways: (1) The nasofrontal duct or the sinus frontalis may open directly into the meatus medius; (2) The nasofrontal duct may be directly continuous with the infundibulum ethmoidale; (3) the nasofrontal duct may be continued down to the infundibulum ethmoidale and meet the latter structure at varying angles; (4) the sinus may have two nasofrontal ducts which in turn may have either of the above relations with the cavity of the nose; (5) rarely the sinus frontalis communicates directly with the sinus maxillaris.

37. In some cases the sinus frontalis has no true nasofrontal duct, but the sinus cavity itself extends well down into the superior and ventral portion of the meatus medius.

38. It is not common for the infundibulum ethmoidale to be directly continuous with the nasofrontal duct. As a rule the nasofrontal duct meets the infundibulum ethmoidale at varying angles. There is frequently a shallow groove connecting the two channels. However, some specimens show that the infundibulum is directly continuous with the nasofrontal duct.

39. If we include the cases in which the infundibulum ethmoidale is directly continuous with the nasofrontal duct, and those in which the nasofrontal duct meets the superior and ventral end of the infundibulum ethmoidale at an angle, they will represent approximately 56 per cent of my specimens. The specimens in which the nasofrontal duct communicates directly with the meatus nasi medius will include approximately 46 per cent of my specimens. The cases in which no nasofrontal duct is present, and those in which two nasofrontal ducts are present are distributed among the above specimens, since they can all be thus classified.

40. From a practical point of view the infundibulum ethmoidale acts as a gutter communicating between the frontal region and the maxillary sinus in 56 per cent of my cases.

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XXI.

ACCESSORY THYROID TUMORS OF THE TONGUE.

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When my attention was first directed to these growths by the advent of my first case, I was surprised to find how little attention had been given the subject by writers in our specialty. The throat books at my command, with the exception of Knight, who dismissed the subject with a few lines, entirely ignored lingual thyroids, and the journals were about as barren. Most of the cases reported have appeared in surgical publications, and have, as a rule, been cases which have come to operation.

My first case occurred in a young lady bookkeeper, 25 years of age, who came to my office on September 16, 1907, complaining of a lump in her throat. She stated that after a visit to her half-brother, who was at the time ill with tuberculous laryngitis, she became nervous about her own throat, and on examining it, discovered a swelling at the base of the tongue, which caused her much alarm. There was nothing in the family history of importance except the half-brother already mentioned; and the personal history was also negative. The patient stated that she had never had sore throat, although her voice had sometimes become a little husky on continued use. She was well nourished, and had every appearance of good health. On examination, a tumor about the size of a large hickory nut was readily seen on protruding the tongue. The tumor was smooth, rounded, somewhat darker in color than the surrounding membrane, and was rather freely covered with blood vessels. On the upper surface was a small bluish spot about one-third of an inch in diameter, which had a fibrous look, and might have been the remains of a portion of the thyroglossal duct, or possibly, a small cyst, exploratory puncture being refused. The growth was painless on pressure, firm and elastic, but giving no evidence of fluctuation, and was apparently not influenced by menstruation.

It was situated immediately behind the circumvallate papillæ, and in contact with the epiglottis below, and gave the appearance of having a perfect right there, the mucous membrane of the tongue extending up over the tumor with no signs of demarkation.

There was no enlargement of the lymphatic glands, nor could the thyroid gland be positively palpated at its normal site in the neck.

This case has been under observation for over three years, and with the exception of some nervousness due to the knowledge of its presence, the patient has had no inconvenience from the tumor, which has remained practically unchanged.

There has been a slight increase in the patient's weight, and the general health has been good.

My second case occurred in an old lady of 79, who consulted me on Nov. 9, 1908, for a subacute pharyngitis and cough following a cold. She made the stereotyped complaint that she had had catarrh for years, but gave no symptoms of a growth, nor was she aware of any. A tumor the size of a chestnut occupied the region of the foramen cecum at the base of the tongue, which had the same characteristics as the case already described, but could be seen only with the laryngoscope. The thyroid gland was apparently present in the neck. This patient recently became choked eating canned corn, and her son, in an attempt to remove the offending body with his finger, abraded the surface of the tumor, causing a rather severe hemorrhage. When I examined this patient's throat a few weeks ago, I found that the intervening two years had produced no change in the tumor, the old lady, now nearly 82, being still unaware of its existence, and in excellent health.

My third and last case, occurred also in a female, the patient being a young woman of 21, employed in a factory, who had been referred to me, January 13, 1909, for a growth at the base of the tongue. This patient had consulted her physician for a cough of two or three months' duration, but up to that time had not been aware of any growth.

An examination of the throat revealed a tumor identical in appearance with the other two, except that it was more deeply placed, arising less abruptly behind the circumvallate papillæ and encroaching more upon the epiglottis. The tumor was about the size of a small hickory nut, and could be seen well only with

the laryngoscope. The thyroid gland could not be positively palpated at its normal site in the neck. There has been practically no change in the growth in the last two years. The only throat symptoms have been a tendency to cough and raise, but there has been some nervousness caused by the knowledge of the presence of the tumor. The general health has remained good, with a slight increase in weight.

In none of these cases was any operation done, or required, the only local symptoms being due apparently to the knowledge of the presence of the tumor, and having no effect upon the general health. There was also the possibility, perhaps I may say probability, in the two younger women, that these tongue tumors might be the only functionating thyroid tissue possessed by them.

I have seen two other cases which were undoubtedly cases of lingual thyroid, although the first was shown at the New York Academy of Medicine by Dr. Freudenthal with a doubtful diagnosis. It occurred in a young woman of 21, and exhibited all the characteristics of this unique affection.

The other case was one reported by Dr. Harris, at the New York Academy of Medicine, on Oct. 16, 1910, in a girl of sixteen. This was partially cystic, and a portion had been removed with strong forceps, and found to contain thyroid tissue. The characteristics of this tumor were the same.

One other case, of which Dr. T. W. Corwin has kindly furnished me with notes, was mentioned by him at the time Dr. Freudenthal's case was presented, but which has not been fully published. The patient was an under-sized boy of fifteen, pale and anemic, with tuberculosis in the family history. The chief symptom complained of, was imperfect speech, extending over a period of two years. Examination revealed a tumor occupying the full width of the tongue at its base, and about one inch in its anteroposterior diameter. About two-thirds of this tumor was cystic, and was of a pale bluish gray color, with numerous veins extending from the tongue over its capsule. The operation consisted in the removal of the fluid contents, and a portion of the remainder for examination, which proved to be thyroid tissue. There was in this case, a tumor the size of a hickory nut, in the median line of the neck, which was excised and found also to consist of thyroid tissue. No thyroid gland could be palpated at the usual site.

In 1904 Storrs wrote an excellent and exhaustive article upon lingual goitre, giving notes upon all cases found by him in the literature up to that time, together with two hitherto unreported cases, making in all thirty-two.

I wish to supplement his list by the addition of thirteen cases, and also to add to it, those cases reported since his paper.

HICKMAN: Female child, born alive, but respiration difficult, and lived but a short time. Large tumor could be felt with the finger at base of tongue. Autopsy showed rounded tumor, projecting one-half inch above the tongue, being one-half inch wide and three-quarters of an inch from before backward. It was hard, covered with normal mucous membrane, and pressed the epiglottis over the rima glottidis. Microscope showed glandular follicles and a rich supply of blood vessels.

LUCKE (reported by Merten): Man, 22 years old, had had tumor near hyoid bone from birth, causing annoyance for the past year. Examination showed tumor size of man's fist, with base at root of tongue. Removed by incision from chin to hyoid bone. Histologic examination showed thyroid tissue and colloid material.

PARKER: Girl, 16 years old, with hemispheric tumor, size of a walnut, at base of tongue. It was firm, slightly elastic, and covered with stretched and congested mucous membrane. It was excised, partially recurred, but reduced again in size, causing no inconvenience. Microscope showed glandular tubes lined with cubical epithelium, some containing plugs of gelatinous looking material.

BERNAYS: Girl, 17 years old, with tumor under chin extending to base of tongue, and causing difficulty in swallowing and articulation. The tumor consisted of two parts, one the size of a bantam's egg, and the other the size of a cherry. On the surface of the smaller tumor was a depression a quarter of an inch deep, corresponding to the foramen cecum. The upper lobe projected into the pharynx, and was covered with mucous membrane. The tumors were enucleated through an incision extending from the inferior maxilla to the hyoid bone. Microscope showed nearly normal thyroid tissue.

WOLF: Girl, 18 years old, complaining of difficulty in swallowing, gave history of swelling in throat since an attack of whooping cough six years before. Laryngoscope revealed a firm tumor the size of a nut, on the left side of the tongue, at

its base. The tumor suddenly enlarged, and, after tracheotomy, was removed by an incision in the median line beneath the chin. The inferior maxilla was divided, lingual arteries tied, tongue split, and tumor enucleated. The tumor consisted of thyroid gland tissue.

STAELIN: Autopsy of a woman 77 years old, revealed a tumor as large as a walnut at the middle of the base of the tongue. It was hard, covered with normal mucous membrane, and buried in the muscles of the tongue. The tumor proved to consist of normal thyroid tissue.

WARREN: Woman, 52 years old, had had a "lump in her throat" for twenty-two years. It had been of very slow growth, until an attack of grip, when it became swollen and inflamed, producing considerable irritation. Examination showed a tumor about the size of a hen's egg, situated at the base of the tongue, covered with normal mucous membrane, with quite a large tortuous vessel upon it. The tongue was drawn forward by ligatures at the tip, and at the dorsum on either side of the tumor, and the growth easily enucleated through a median incision. Three vessels required ligature. The structure of the tumor proved to be that of the thyroid gland.

BUTLIN (two cases): First case.—Female, 32 years old, afflicted with sore throat, presented a round smooth tumor, the size of a hen's egg, on pulling out the tongue. It was covered with mucous membrane, was elastic, puncture being followed by severe hemorrhage. After tracheotomy the tongue was pulled out, and the tumor removed. There was some recurrence, but no return of the symptoms.

Second case.—Female, 22 years old, with history of having vomited blood occasionally for four years. Had noticed swelling at base of tongue two years before, and it was lanced with much bleeding. Recently she had had difficulty in speaking and swallowing. The tumor was identical in appearance with that of the preceding case, but smaller. Tumor was partly removed by galvanocautery loop, with some return, but not enough to cause inconvenience. Both tumors showed microscopically cystic tubular adenomata of thyroid origin.

GALISH: Female, 24 years old, after the noon meal, having a fit of coughing, raised half a pint of dark blood. Repeated hemorrhages followed, causing a mistaken diagnosis. An accessory thyroid had previously been removed from the neck.

Laryngoscope showed an elastic tumor, the size of a cherry, attached to the base of the tongue, covered with deeply injected mucous membrane. Puncture resulted only in hemorrhage. Tracheotomy was performed, and the tumor was enucleated with much hemorrhage, through a T-shaped incision, the vertical portion dividing the hyoid bone. The tumor consisted of very vascular thyroid tissue.

BABER reported to the Society of Laryngology, at London, October 10, 1894, the case of a young girl 16 years old, who, for nine months, had had a swelling at the base of the tongue. It was removed by the galvanocautery loop, but soon reappeared. The tumor consisted of thyroid tissue, without cysts.

BOND: McIlraith reports a girl of 17, who had noticed a lump in the throat for two months. The voice was a trifle thick, with no other symptoms. Examination showed an immovable, semi-elastic tumor, the size of a walnut, situated close to the foramen cecum. The thyroid was normal. The tumor was removed by raspatory and snare, after cutting the membrane around the tumor with curved scissors. There was profuse bleeding. The structure of the tumor was that of the thyroid gland.

LAKE referred to a case of lingual goitre observed by him, at a meeting of the London Laryngological Society, Oct. 10, 1894, in the discussion of Baber's case.

LYMPIUS: Female, 34 years old, had had for some years a sensation of suffocation and hoarseness, and for two years a swelling at the base of the tongue. This increased in size, causing difficulty in speaking and swallowing. A hemorrhage was followed by increased size of tumor, and bleeding also followed when tumor was lanced. Examination showed a firm growth the size of a walnut, situated at the base of the tongue, pressing upon the epiglottis, and covered with blood vessels. Tracheotomy was performed, the palatoglossal muscles incised, the tongue drawn forward, and the tumor enucleated, accompanied by severe hemorrhage. The tumor was composed of very vascular thyroid tissue.

SELDOWITSCH: Girl, 14 years old, having a round, smooth, firm swelling, the size of a cherry, near the foramen cecum at the base of the tongue, which caused her considerable annoyance. Tumor was removed by galvanocautery loop, and

proved to be of thyroid structure. Six months later all the symptoms of myxedema were present. No thyroid could be felt.

KRASKE (reported by von Chamisso): Woman, 37 years old, afflicted with cretinism with complete absence of the thyroid body. Symptoms were disturbance of speech, deglutition and respiration. At the base of the tongue, slightly to the right, was a smooth swelling the size of a walnut, covered with vessels. It was in part, firm, and in part, fluctuating. The operation consisted of tracheotomy, traction on the tongue, and enucleation. Structure was in part embryonic thyroid tissue, and in part ordinary thyroid tissue with colloid degeneration. Four months later symptoms of myxedema were present, and the patient was treated with thyroid extract.

REINTJES reported a case of lingual goitre to the Society of Laryngology, Rhinology and Otology of Holland, May 23, 1898. Man, 25 years old, troubled with severe hemorrhages without apparent cause other than swallowing a large mouthful of food. At the base of the tongue could be seen a dark brown swelling, smooth and elastic, and covered with large veins. Tracheotomy was performed, traction made on the tongue, the anterior pillar of the fauces divided, capsule of the tumor split, and tumor shelled out. The tumor consisted of thyroid substance.

TREITEL reported before the Berlin Medical Society, May 25, 1898, a case of presumable lingual goitre, which had existed for twenty years in a woman. Symptoms slight, and no operation.

LEFFERTS (two cases) casually mentions having observed two cases of goitre at the base of tongue, neither of which has been published.

VAN SELMS observed a woman with a tumor at the base of the tongue which had developed as a sequel to strumectomy.

BENJAMINS reports case of goitre at base of the tongue in a man. True thyroid absent, and operation followed by symptoms of myxedema.

MEYJES reported a case before the Society of Otology and Laryngology of Belgium, June 17, 1899, of a woman, 24 years old, who had had the sensation of a foreign body in the throat since childhood. She occasionally spat up bloody mucus. Examination showed a round, smooth, immovable and painless

tumor, occupying the right half of the tongue, at its base. It protruded 2.5 centimeters, and was covered with dilated vessels. No true thyroid could be felt. There was no operation.

SCHADLE (two cases): First case.—Woman, 25 years old; had for the past six months noticed a growth at the base of the tongue, causing her much mental discomfort. There was some impairment and thickness of speech. Examination showed a hard, immovable tumor, the size of an English walnut, covered with a vascular, purplish-red mucous membrane. The tumor became swollen during suppressed menstrual function. Several violent hemorrhages occurred, and the tumor was enucleated through an incision from the symphysis menti to the hyoid bone. The structure was that of the thyroid gland.

Second case.—Woman, 23 years old, who had had a growth at the base of the tongue for ten years. There was lack of resonance to the voice, difficulty in swallowing, and cough. Inspection showed smooth, dense, dusky-red tumor, with characteristic resilient feeling. Operation was refused.

HOLMES reported a case in every respect similar to that of Dr. Schadle. The tumor was partly removed by galvanocautery.

WATSON (two cases): First case.—Woman, 50 years of age, having had "a lump in her throat" for ten years, which recently had enlarged, causing great dyspnea and dysphagia. Examination showed a smooth firm tumor at the base of the tongue, one and one-half inches long, one inch wide, and one inch thick. There was ulceration at the top of the tumor. A part of the tumor was removed by the galvanocautery loop, and found to have the structure of a degenerated thyroid body.

Second case.—Colored girl, 16 years old, complained of "a lump in her throat" five years, which had recently interfered with swallowing. Growth in every way like the preceding case, except that its surface was not ulcerated. The tumor was removed with the galvanocautery snare, and its structure found to be that of the thyroid gland.

ASCHOFF: Female infant, six months of age, with total absence of the thyroid having signs of mild myxedema. Tumor at base of tongue the size of a large pea, composed of numerous small cavities filled with colloid-like glistening contents.

VALLAS: Girl, 20 years old, complaining of difficult swallowing and altered voice. Examination showed an elastic, painless tumor, the size of a small nut, behind the foramen cecum. The tumor was removed twice; the second time through a median incision in the neck, dividing the hyoid bone. Histologic examination showed structure of the thyroid gland.

WAKABAJASKI: Woman, 20 years old, showing for three months progressive pains in the region of the thyroid cartilage, hoarseness, dysphagia, and sensations of a foreign body in the pharynx. An immovable tumor, nearly the size of a pigeon's egg, and covered with normal mucous membrane, was situated at the base of the tongue. Extirpation by the mouth was followed by recovery. Microscope showed goitre tissue.

NARATH is reported as having observed a case of goitre at the root of the tongue.

THEISEN: Woman, 67 years old, had a tumor identical in every way with those reported by Drs. Warren and Schadle. When young the patient had had a well marked goitre, which had now disappeared. Operation was not advised.

LASSIN is quoted by v. Eiselsberg in his monograph on diseases of the thyroid, 1901.

CURTIS and GAUDIER: Woman, 21 years old, complaining of difficulty in swallowing and talking, had had a growth at the base of the tongue for five years. Examination with a laryngoscope showed a round tumor, covered with vascular mucous membrane. It was elastic, almost soft, and imbedded in the muscles of the tongue. The thyroid body was small. The tongue was drawn forward, and a silk suture passed under the mass of the tumor, which not only assisted in drawing out the tongue, but acted as a hemostat. The tumor was enucleated through an incision in the mucous membrane covering. Bleeding was profuse. The structure was that of a typical thyroid gland.

WINSLOW: Girl, 17 years old, complained of difficulty in swallowing, muffled voice, and sore throat. Examination showed a smooth, elastic, ovoid mass, half the size of a hen's egg, at the base of the tongue, between the foramen cecum and epiglottis. Tumor was enucleated through a median incision from the chin to the hyoid bone. Structure was that of the thyroid gland.

TEWELES: Girl, 14 years of age, whose voice had had a peculiar sound for three years, becoming very nasal the last year. Snoring at night was the only other symptom. A tumor, with broad base, covered with normal mucous membrane, was found at the root of the tongue, obstructing the entrance to the pharynx. The tongue could be drawn out sufficiently by strong threads to permit the extirpation of the growth. The microscopic findings were parenchymatous goitre, without colloid, surrounded by a distinct connective tissue capsule. Recovery complete.

SMITH, T. L.: Woman, 48 years of age, who presented a tumor the size of a walnut,, at the base of the tongue, directly back of the circumvallate papillæ. It was covered with mucous membrane highly vascularized, and locally eroded, and was firm, elastic and almost hard. The operation was performed through a mesial incision in the neck, dividing the hyoid bone, and enucleating the tumor in part by blunt dissection. Recovery followed. Microscopic diagnosis was thyroid tissue with mild colloid cystic degeneration.

ONODI: Woman, of 26, who for nine months had suffered from disturbances of swallowing, and more recently, radiating pains toward the ear. A tumor the size of a hazel nut was discovered at the base of the tongue, and was removed through the mouth under local anesthesia. The tumor had a connective tissue capsule, and was found to consist of thyroid tissue, which was largely in a state of colloid degeneration.

GAUDIER and CHEVALLIER: Girl, 20 years old, had had a tumor at base of tongue three years. The tumor was enucleated through a median incision, dividing the hyoid bone. As no normal thyroid gland could be found, a portion was left to avoid myxedema. Section showed thyroid tissue.

GORIS: Gaudier and Chevallier cite an unpublished case, in which myxedema followed the removal of the tumor. The tongue was drawn forward after cutting it from its anterior insertions, and the tumor removed through the mouth.

HANSZEL: Rare tumor at the base of the tongue in a woman 50 years of age, who for 21 years had been suffering from slight impairment of speech, and some respiratory disturbances. A tumor of cartilaginous consistency, the size of a small apple, and entirely filling the faucial isthmus, was found attached by a broad base to the root of the tongue. The submaxillary

lymph glands were swollen. A small piece was removed from the crest of the tumor with galvanocautery for examination, and no thyroid tissue found, but as the ablated segment was very small, and especially as the thyroid gland could not be palpated, the case was interpreted as one of lingual goitre.

CRANDON: Girl, 9 years old, who had noticed a growth in her throat for a year and a half. She complained of great dyspnea when in the recumbent position. A year ago an attempt at removal was stopped by severe hemorrhage. Examination showed a smooth, ovoid, elastic growth, the size of a nut, situated at the base of the tongue, and covered with mucous membrane.

RIETHUS: Servant girl, 17 years old, who had been somewhat hoarse for a year, and had had pain and sensation of a foreign body in swallowing for five months. On depressing the tongue a bulging hemispheric tumor could be seen at its base. After preliminary tracheotomy the tumor was easily removed by means of subhyoid pharyngotomy. The operation was followed two months later by symptoms of myxedema. The tumor consisted of colloid thyroid tissue with small cysts.

SMITH, OLIVER C.: Woman, 50 years of age, giving history of growth at back portion of the tongue for seven years, it having twice recurred after removal.

When seen, voice was nearly inaudible, speaking, swallowing and chewing being difficult. Drawing the tongue forward revealed an ovoid tumor at its posterior third, obscuring the epiglottis, and rising nearly to the roof of the pharynx. It was neither painful nor tender. The thyroid gland was apparently normal. Removal was accomplished under cocain, through the mouth, with insignificant hemorrhage, by the ecraseur.

Histologic findings: Accessory thyroid tumor of the tongue.

MIXTER: Woman, 24 years old, had noticed a swelling at the back of the tongue three weeks, which caused no symptoms. Examination showed a mass the size of a small hickory nut, on the dorsum of the tongue, and another the same size under the symphysis of the jaw. The tongue tumor was removed through the mouth, after drawing the tongue forward by strong sutures on either side of the tumor, and was found to consist of thyroid tissue.

ALLEN-INGERSOLL-LUDLOW: The authors report the case

of a girl, 18 years of age, who complained of progressive difficulty in speaking, some disturbance in swallowing, and interference with respiration on exertion. Examination showed hemispheric immovable tumor at base of tongue, completely hiding epiglottis and larynx, and covered with normal mucous membrane. The growth was removed by the mouth, accompanied by alarming hemorrhage. Slight paralysis of one side of the tongue followed the operation. Histologic examination showed the tumor to correspond in structure to the thyroid gland.

MURPHY, J. B. (two cases): First case.—Woman, 34 years of age, who had had tumor at base of tongue fifteen years before, when an attempt at removal by the mouth had to be abandoned because of severe hemorrhage. No further trouble was experienced with this growth, but later a submental tumor developed to the size of a hen's egg, which was removed by external incision.

Second case.—Male, 45 years of age, three weeks previous to admission noticed a swelling at the base of the tongue slightly to the left. No symptoms. On removal microscope showed large glandular lumina filled with colloid material. Dr. Murphy advises removal of these tumors by the subhyoidal or submental route.

MEIXNER (two cases): The first case was a girl 20 years old, who complained of pressure in the pharynx for four months. A tumor the size of a chestnut was found at the base of the tongue. It was excised through the mouth after division of the glossopalatine arch, the tongue being pulled forward with forceps. Four months later patient began to have symptoms of impaired thyroid function. The second case was a newborn female infant, born alive, but found drowned shortly afterwards. A lingual thyroid was found at the base of the tongue pressing the epiglottis forward forcibly over the larynx. There was no thyroid at the normal site on the trachea. The microscopic examination showed undoubted presence of thyroid tissue.

EWALD: Meixner refers to a case of lingual goitre which has never been published. Dr. Ewald informs him that while dissecting the cadaver of a child in 1890, during his service at the Institute for Forensic Medicine, he discovered a lingual goitre, the diagnosis afterward being confirmed.

LENZI: Woman, 42 years of age, presenting two tumors, one hard, smooth tumor in the submaxillary region, and the other the size of an egg at the base of the tongue, giving rise to disturbances in swallowing. Both tumors were enucleated from the outside. On the eighteenth day a postoperative psychosis appeared, with excitement, and persecutory ideas followed by a stuporous condition. Typical myxedema developed at the same time. The microscope showed both tumors to be made up partly of normal functionating thyroid tissue.

SCHWARZ, D.: Woman, 28 years of age, who stated that when 15 years old she had had a tumor removed from under the chin. For the last year she had had disturbances in swallowing, finally being able to take only liquid or soft food. There was a smooth elastic tumor, the size of a hen's egg, covered with normal mucous membrane, situated in the middle of the base of the tongue, just behind the foramen cecum, partly imbedded in the lingual substance. The tumor was removed by median transhyoid pharyngotomy, with preliminary tracheotomy. The tumor was not outlined by a capsule. The histologic findings showed thyroid tissue, with colloid degenerative changes.

WIKERHAUSER, T.: Woman, 32 years old, had suffered for two months from pain in swallowing, dyspnea, headache and fever. A tumor the size of a nut was found at the base of the tongue, mostly to the left side and situated in a depression in the muscles of the tongue. The mucosa overlying the tumor was smooth and reddened with dilated veins. No operation was performed, as no thyroid gland could be demonstrated in the neck, and the patient drifted from sight.

MAKINS: Woman, 31 years of age, suffering from dysphagia and dyspnea, presented a tumor the size of a walnut at the base of the tongue. The tongue was drawn forward, the capsule incised, and the tumor partially enucleated with the finger and blunt raspatory. The tumor was found to have largely undergone colloid degeneration.

STRAUSS: Woman, 25 years of age, who was suffering from the early symptoms of exophthalmic goitre, presented a globe-shaped tumor the size of a small walnut at the base of the tongue in the region of the foramen cecum. The tumor, which was fairly solid, was removed by external

pharyngotomy. The operation proved very difficult, and required the ligation of a well developed venous plexus, and the left lingual artery. Histologic examination showed the tumor to consist partially of normal thyroid tissue, and partially of thyroid tissue in a state of colloid degeneration.

UNGERMANN: Autopsy of a man, 30 years of age, which seemed to show the absence of the thyroid gland from its normal position, and instead, a functionating thyroid tumor the size of a chestnut at the base of the tongue. The tumor was solidly adherent to the neighboring structures, and showed moderate colloid degeneration. There had been no symptoms of lost thyroid function during life.

STIRLING, R. A.: Girl, 12 years of age, who gave a history of progressive difficulty in swallowing and speech. Inspection showed rounded swelling, about the size of a very large marble, placed in the center of the base of the tongue, and projected upward between the fauces. It was covered with very vascular mucous membrane. After preliminary tracheotomy, the tumor was enucleated by the finger and scissors, with very free bleeding. A small thyroid was found to be present in the normal position. Microscopically the tumor consisted of more or less typical glandular thyroid tissue.

PERKINS: Child, 12 years of age, with a peculiar thickness of speech. Examination showed a tumor the size of a hen's egg, situated at the back of the tongue. It was bluish-red in color, elastic to the touch, and freely movable. A rent was made by plunging Knight's nasal forceps through the capsule, and through this a portion of the tumor was enucleated with the finger. The microscopic examination showed thyroid tissue with the presence of colloid material.

STUART-LOW: Woman, 32 years of age, presenting a lingual thyroid after previous removals by the mouth. Laryngotomy was performed, the larynx tamponed, the tongue split from tip to root, and the tumor enucleated with its capsule. The substance of the tongue was so thinned in the vicinity of the tumor that the tongue was preserved with difficulty. The author believes this method superior to subhyoid pharyngotomy, or a galvanocaustic operation by the way of the mouth.

The tumor proved to be of a thyroid adenomatous nature.

These sixty-one (61) cases, together with those of Drs.

Freudenthal, Harris and Corwin, mentioned earlier in this paper, comprise all the cases found by a careful search of the literature, and with the three of my own here reported, make a total of sixty-seven cases up to the present time.

Many other cases of aberrant thyroids, which do not come under the title of this paper, have been reported, and one by Goris has some interesting features. A woman, fifty years of age, fell, and crushed her tongue between her teeth. Soon afterward a tumor developed at the tip of the tongue, rapidly increasing to the size of a large hazel nut. After extirpation the growth was found to possess the same structure as the well-known ulcerating goitres of the cervical region.

When we consider the comparatively small number of lingual thyroids reported, and when we consider the statements of men of unlimited experience and keen powers of observation, like that of our secretary, Dr. Harris, who stated that the case presented by him at the New York Academy last October was the first he had ever seen, we must admit the rarity of this condition. In spite of these facts, however, I cannot help believing that the affection is much more common than has been generally supposed, that many people go through life with this condition unsuspected, and that many other cases accidentally discovered and giving no symptoms, never have been reported.

In vertebrates it is found that the thyroid gland consists rudimentarily of three parts, one mesial and two lateral. The former is derived from the epithelium of the primitive mouth cleft which grows downward as a fold through the approximation of the mesial end of the second branchial arch, with that of the third and the tuberculum impar. This fold, as the neck extends and the large vascular trunks descend, becomes transformed into a tube, the lower blind end of which is capable of producing thyroid gland tissue. This duct, ductus thyreoglossus, passes from the isthmus of the thyroid to the foramen cecum at the base of the tongue, and, normally, is obliterated and becomes a cord of epithelium.

Little is known of the development of the lateral germ, but it is generally assumed to originate from an epithelial accumulation at the posterior wall of the fourth branchial cleft or behind it from the postbranchial organ. In close

proximity to this from the anterior wall of the fourth branchial cleft, arises the upper parathyroid body, which relation they preserve, both through their migration and permanently. Views differ as to the behavior of the lateral germ, and it is possible that its development in a normal manner depends upon the influence of the development of the median germ, accounting for the fact that when there is a failure of the latter there is also failure of the former.

Tumors are ordinarily supposed to be without function; but the unique feature of these growths is that they are capable of assisting a disordered thyroid gland, or fully taking its place when that is wanting. There is much evidence to show that the necessity for additional secreting thyroid tissue is in a large measure accountable for their development.

To understand the etiology of these tumors, it is necessary to remember that the thyroglossal duct, or tract, as it is sometimes called, may apparently retain the power of producing thyroid tissue at any portion of its course, the vicinity of the foramen cecum at the base of the tongue being the most favored location. This may take place when there is a functionating thyroid gland in the neck, but what is undoubtedly much more common, is in those cases when the natural thyroid tissue is defective or wanting.

Lenzi believes that these tongue tumors represent the thyroid gland as a whole, it having been fixed in this location in an earlier stage of development. He reasons, therefore, that signs of defective thyroid secretion must follow the radical removal of these tumors, and concludes from a study of the literature, that myxedema has appeared in twenty-two per cent of the operated cases. This is probably approximately correct for the sixty-seven reported cases, but an accurate estimate of the number of operated cases having no other source of thyroid secretion is difficult, for the operations have been performed with all degrees of thoroughness, from the removal of a piece for examination, to the complete extirpation of the tumor. If there had been a radical operation in every case the number of resultant cases of myxedema would unquestionably have been greatly increased.

The normal thyroid gland is present at birth and functionates throughout childhood, but is most fully developed and

active from puberty to the menopause. After the latter period the secretion is diminished, and the gland gradually atrophies.

These accessory thyroid tumors of the tongue follow much the same course, and may also be present at birth, or at any age, the oldest recorded case being my own, at eighty-two. The great bulk of reported cases have occurred, however, between the ages of fifteen and forty-five, corresponding to the period of greatest functional activity of the thyroid gland; and here comes an interesting question:

Has the tumor been present from birth in many of these cases, or has it developed only at the time of increased thyroid activity?

It would seem probable that where the normal thyroid was wanting from birth, that the tongue tumor had probably existed from that time, but where the thyroid gland was partially effective at birth or became defective later, the tongue tumor might develop when the additional thyroid secretion was required. In the cases which have been seen late in life it is probable that the growth has existed from the active thyroid period at least. Sex also seems to exert a marked influence; all but six of the sixty-seven cases occurring in females, the exceptions being the cases of Lucke, Reintjes, Benjamins, Murphy, Ungermann and Corwin. In this, also, these tumors follow the inclinations of the thyroid gland, disturbances being much more frequent in females. The situation in brief then is, that the tissue of the thyroid duct at the foramen cecum, retaining the power to develop thyroid tissue, and stimulated by the defect in the normal gland, devolops this functionating tumor, which is perfectly capable of supplying the place of the defective gland, and subject to exactly the same influences.

The diagnosis should be made exceedingly easy by simple attention to the symptoms, or rather lack of them, and the appearance and characteristics of the tumor, particularly when the thyroid gland is absent.

The symptoms of lingual thyroids are mechanical, due to the size and rapidity of growth of the tumor, and nervous, due to the knowledge of its presence. If the tumor is stationary, as it undoubtedly often is, as in Warren's case, where it had been known to exist twenty years; or is of very slow growth, there may be no symptoms, particularly if its presence is unknown

to the patient. But if the tumor is large, or suddenly becomes increased in size, there are symptoms of obstruction, a lump in the throat, swallowing, raising, coughing, and in extreme cases, dysphagia and dyspnea. That the mind has much to do with the symptoms in many cases, is readily understood, when we consider the symptoms complained of in cases of imaginary growths in the throat. A young married woman recently came to me, complaining of symptoms far more marked than those of the ordinary accessory thyroid. She was unable to eat or sleep, and had lost twenty pounds in weight since seeing a growth in her throat when examining it herself during a cold. The growth proved to be a rather prominent epiglottis.

These thyroid tumors are very vascular, being supplied by branches of the lingual arteries, and hemorrhages have been in many cases a prominent symptom. Sudden and severe hemorrhages, with no apparent cause, have frequently led to mistaken diagnoses. Only one of the cases of which I have had personal knowledge, has shown this symptom, the old lady already mentioned, whose son injured the tumor with his finger in trying to remove a foreign body.

The appearance of the tumor is very characteristic; a smooth, rounded, painless growth behind the circumvallate papillæ, usually immovable, and, as a rule, firm and elastic, without fluctuation.

The tumor is usually in contact with the epiglottis, but not adherent to it, and there is no enlargement of the lymphatic glands.

The mucous membrane is continuous with that of the tongue, but is usually darker in color and more vascular, and in but two cases (Watson and T. L. Smith) was it eroded. The absence of the thyroid gland confirms the diagnosis. The tumor is usually encapsulated, but this is not always so, as seen in the cases of Schwarz and Ungermann. Ungermann's case, which was of especial interest, occurred at the autopsy of a man 30 years of age, who during life had had no symptoms of the growth, nor of thyroid insufficiency, and whose thyroid gland was proven absent by dissection. It also proved the thyroid gland to be in no way functionally connected with the parathyroids. Microscopically, the accessory thyroids are like the

thyroid gland, showing thyroid tissue capable of internal secretions, and a colloid material, which seems to act as a storehouse for some of its activities.

Many of these cases require no treatment, and many others require simply to be reassured, or given simple sedatives. Any remedy of value in disturbances of the thyroid gland would also be of value in disturbances in an accessory thyroid. Lenzi, Stuart-Low, and others, place especial emphasis upon the importance of ascertaining the presence of other thyroid tissue before removing this radically.

Myxedema is not as serious an affection as before the advent of thyroid feeding, but it is still much less to be desired than the average thyroid tumor of the tongue. Whenever urgent symptoms are present the treatment is essentially surgical. There seems to be a wide divergence of opinion as to the best means of procedure for the removal of these growths, but the buccal route would seem as effective, and much less formidable, than pharyngotomy, with or without tracheotomy.

The chief indication is the control of the hemorrhage, and for that reason the galvanocautery and ecraseur have been used. A popular method seems to be to draw the tongue forward by strong traction sutures, with or without severing some of its posterior attachments, and removing the tumor by blunt dissection. Stuart-Low, after performing laryngotomy, split the tongue from tip to base to gain access to the tumor, and considers this the most feasible method, especially in deepseated growths. There have been no reported deaths following operation, but severe hemorrhage has, in a few cases, caused the operation to be abandoned.

CONCLUSIONS.

1. That accessory thyroid tumors of the tongue are more common than has been generally supposed.
2. That they result from nature's effort to supply a physiologic need.
3. That they frequently require no treatment, and should be considered simply as a misplaced thyroid gland.
4. That care should be taken to ascertain the presence of some other source of thyroid secretion before removing radically.

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XXII

REPORTS OF THREE CASES OF MENTAL DERANGEMENT ASSOCIATED WITH SUPPURATIVE OTITIS MEDIA.

By Ewing W. Day, M. D.,

Pittsburgh.

Case I.—The patient is a woman, aged 55, who has been a widow for many years. She is a bright, active, intelligent woman—reserved, sensitive, self-reliant and independent. For some years she has filled the rather difficult position of clerk to a school board, and besides this, she took a very active part in church work and devoted some time to social duties.

February 4th, 1910, she noted that there was some discharge from her ear; but as this seemed rather trifling she did not at first seek medical aid. The discharge persisting, Dr. Sandels was asked to examine her. He did so and discovered a streptococcic otitis media; and fearing the development of mastoid disease, the patient was removed to the Eye and Ear Hospital. Here for several days she was under our observation. It was decided that there was no mastoid trouble and that the disease was confined to the middle ear. During the time she was in the hospital, she got hardly any sleep at night. She was not under hypnotics for fear they might mask her symptoms.

While under observation, the patient was greatly worried over the thought that a mastoid operation might be called for, and still more over the idea (being a sensitive woman) that she might become crippled in her usefulness and become dependent upon others for support.

During the last three or four days at the hospital she became agitated, loquacious and hard to manage. This mental state became more and more pronounced until she developed a maniacal state.

While in this condition she was removed to the Mercy Hospital under Dr. Diller's care. Her condition remained stationary for about two weeks; and then she began to improve

somewhat. No attention had been paid to her ears except to have them cleansed several times daily.

Upon admission to the Mercy Hospital, it was noted that she had a "run-around" on one finger. Shortly after admission she developed a swelling the size of the palm of the hand on the buttock; and although it was expected for several days that it would require lancing, it finally subsided gradually and disappeared.

Three weeks after her removal to the Mercy Hospital it was noted there was some swelling over the right mastoid, and an immediate operation was advised; this was done. Pus was found in the mastoid and an epidural abscess was found over the cerebellum. Very soon after the operation the patient's delirium increased. She became disorientated, peevish, faultfinding and quarrelsome. She abused the physicians, nurses and the hospital, and criticized them in the most cutting way. She objected to much that was done for her. Physical restraint became absolutely necessary to prevent her interfering with her bandages. Her mental state made it extremely difficult in every way to manage her. The operative wound did badly. It lay gaping open for about a month and showed no signs of healing. The patient developed irregular temperature and her pulse was weak and slow and her delirium increased. The wound sloughed at the bottom and even appeared gangrenous. For a time it seemed as though there could scarcely be any hope for her recovery.

With the failure of the wound to heal, it was also felt there might be some general systematic blood infection. Accordingly cultures were made from her blood by Dr. Leteve, which revealed the presence of streptococci An autogenous vaccine was made and used in doses of 100,000,000 for six injections. With the use of the vaccines a turn for the better set in. The physical condition steadily improved, but not the mental.

Gradually, very gradually, some slight improvement was noted in the wound. And gradually and very slowly it healed, weeks being consumed in the process. All the while her peculiar mental state, characterized by restlessness, peevishness, disorientation, censoriousness, continued; and nursing of the patient and her management in general were most difficult.

Finally, after many weeks, she nad sufficiently recovered to

leave the hospital, which she did early in July, about three months after the mastoid operation. At this time the wound was healed and her mental state was much improved, this mental improvement having been of only very recent occurrence. She remained away at two different sanitoria convalescing, and finally returned to the city about October 1st, nearly well. Even after she left the hospital for the sanitorium she had many false conceptions and exhibited some false reasoning, suggestive of a paranoid state. At one time she became so agitated at the sanitorium that her removal was demanded. She was taken to another sanitorium, where she did much better; here her convalescence became uneventful, with full recovery from the mental state.

The following explanation of this case and the relationship of the operation to the mental state appears as the most reasonable one:

A sensitive, delicate, high-strung woman, who is working very hard, making her own living, attending church and social duties, is, while in a state of lowered vitality, seized with otitis media. The otitis media causes in her mental state a subacute and then acute delirium. Her lowered vital tone permits the infecting process in the middle ear slowly to spread to the mastoid. And this same condition of vitality prevents the wound from healing. The behavior of the wound affords ample proof of the fundamental condition—lack of vital tone, lack of resistance to bacterial infection—and more than that, lack of resistance to psychic or mental traumata.

The mental state, it is reasonable to suppose, was brought about by combination of etiologic factors. These were first and fundamental, the lowered or depressed vital tone which naturally affected the mental operations, together with the double traumata of the operation—for it had both its mental and physical aspects. And then to keep up the mental state, which is initiated by the foregoing causes, we have the toxemia from the infection.

So that in this case it would not be correct to say off-hand that the otitis media and operation caused the delirium, and yet it can be seen that they had their influence in producing it. But the point for emphasis is that they produced the delirium only because the patient's general condition amply prepared her for it; it was so weakened that it was unable to resist even a slight assault.

CASE II.—L. L. R., male, age 30, referred to me for O. M. P. C.—existing since childhood. An ironworker by occupation, well developed, with no previous history of importance excepting scarlet fever in infancy. For two weeks had had pain in right mastoid with increased discharge of pus and complete facial paralysis on right side. Patient seemed depressed and worried over the prospect of an operation.

The radical mastoid was performed and a necrotic area was found over the facial nerve. After three weeks he left the hospital to be attended by his physician in a neighobring state. The facial paralysis had disappeared and the wound healed well. Returned in one month, complaining of severe headaches, chiefly vertical, sometimes occipital and frontal. Had a marked optic neuritis in right eye. A diagnosis of abscess was made. The patient was much depressed mentally, was fearful of the coming operation, and required the presence of his priest in the operating room. Nothing was found in the brain or dura to indicate either pressure or pathologic changes. For a couple of weeks after, he seemed like the average patient. The optic neuritis partially cleared. Then he again showed depression, having many imaginary ills. Complained of immoral conduct of his nurses, and had other delusions.

He was seen by Dr. Diller and found to be in the condition of dementia which should probably be classed as one of dementia precox. He was taken to St. Francis Hospital. Here he exhibited mutism, disregard for his surroundings, with lack of initiative and desire, which seemed to label him pretty clearly as a case of dementia precox. The patient remained at the hospital for many weeks without showing any substantial signs of improvement, although during his stay there the wound healed.

Here again is a case of a grave form of insanity, apparently chronic in form, caused by operation on the mastoid. Here again it may be safely assumed that while the operation was in all probability the precipitating cause of this grave mental state, yet it is also safe to assume that it was only the precipitating factor operating upon a man whose general organism and mental makeup were fully prepared for giving expression to such psychosis. In other words, any other trauma, physical or mental, we may suppose would have set up such a psychosis. We need not expect such an outcome in persons of ordinary

health. Yet it must be confessed in this case such a predisposition could not be discerned before operation.

And it may be here stated that in any case where delirium is produced by operation, we may be pretty sure it so happened only because of the fact that the patient had somehow been prepared for it by a depressed psychic tone. A question of practical importance arises here. Where there is reason to suspect the probability of mental breakdown in a case where serious operation is indicated, it becomes the part of prudence in the surgeon to consider this possibility.

The next case is in direct contrast in physical and mental makeup to case I.

CASE III.—A man, aged 52, of stolid appearance, phlegmatic temperament, one not easily susceptible to mental impressions.

He was brought to my office October 18, 1910, complaining of pain in the right side of his head. He had lately shown mental derangements.

Personal history: Negative.

Present illness: In March the patient had an acute suppurative otitis media complicating grip. The discharge was very free, but the patient suffered very much, early in the attack, from severe pain in the ear and frequent spells of dizziness. Occasionally there was some vomiting. The ear continued to discharge for one month. Since then there has been no discomfort directly referable to the ear, but the patient has complained almost constantly of some headache on the right side.

Early in October the headaches had increased until a week before seeing him they were so severe that sleep could only be obtained under opiates. With the increase of pain, an irritable temper and mental hallucination developed. He had to be watched for fear of suicide, which he threatened, and tried at one time to throw himself from an upper window.

He entered the hospital October 20, 1910, and was examined by Dr. W. K. Walker as to his mental condition, who made the following report:

Patient was examined by Dr. Walker two hours before operation. With the exception of cephalic pain which, according to the patient's statement, was most marked over the entire right side, no localizing symptom could be elicited. He was well orientated in all three spheres—time, place, and personality (no delirium), and there was no more marked dulling of the

mental faculties than that which could be explained by long-continued suffering (irritability).

He presented the picture of a man who was suffering intense pain, with apprehensiveness and anxiety as to further suffering, greater than he could bear.

He explains his more marked agitation of the night hours as follows:

"Either the pain gets worse at night, or else I am less able to bear it; I can't sleep, so I walk the floor; and if I said I'd throw myself out of the window, I meant that if the pain can't be stopped I'd rather be dead."

Examination of the ear showed there was no discharge, the membrane was intact with injection of the vessels. There was one point of tenderness about one-half inch below and behind the antrum.

X-ray showed the right mastoid to be opaque.

10-20-10. Mastoidectomy was done one hour later. No pus or necrosis was found in the mastoid, antrum, or middle ear. The sinus was uncovered, and while the wall of the sinus did not appear unhealthy, there was a peculiar yellow tint that made an exploratory puncture seem to be indicated. The sinus was found to contain a well organized clot extending from half way to the torcular to the jugular bulb. No return flow being obtained from the bulb, the bulb was opened and curetted, followed by ligation of the jugular vein.

Unfortunately, the specimen of the clot was lost before reaching the laboratory, so whether it was infective or sterile is unknown. As the clot was well organized and firm, showing no signs of breaking down, it was probably the latter, or the infecting organism had become greatly attenuated.

The interesting clinical feature of the case is the entire absence of all the clinical symptoms of thrombosis, with the exception of the infrequent one of pain, and pain of such severity that the patient's mental condition was questioned.

Following the operation the patient's temperature never was above 100; he had decreasing pain for two days, which then disappeared. Otherwise his convalescence was uneventful.

XXIII.

SUBDURAL DRAINAGE IN PURULENT MENINGITIS AND BRAIN ABSCESS. REPORTS OF TWO CASES WITH AUTOPSIES.

By Ewing W. Day, M. D.,

Pittsburgh.

Case I.—Mr. C., aged 30, white, consulted me for the first time December 6, 1910, for pain in and around the right ear and severe periodical headaches.

Family history—Good.

Personal history—Outside the ordinary diseases of childhood, he had always enjoyed good health. At the age of two and a half years, he had scarlet fever which left him with a chronic suppurative otitis media of the right ear. Except for the discharge and gradual loss of hearing, he suffered no discomfort from the ear.

Present history—Four months before he consulted me, he suffered severe pain in the ear and right side of his head. The pain continued for about three days, during which time there was some decrease in the amount of discharge. Following this attack, he suffered frequently from vertigo. In December he had a similar attack and it was at this time I saw him. He referred his pain to the mastoid region. Examination of the ear showed the usual destruction of an O. M. P. C.

Examination of the labyrinth was as follows:

1st. No spontaneous nystagmus.
2nd. No spontaneous nystagmus behind opaque glasses.
3rd. Absence of nystagmus by quick head movement.
4th. Caloric reaction negative.
5th. Turning reaction active.
6th. Hearing, deaf.
7th. Romberg test, positive. No marked direction.
8th. Some tinnitus.

Operation was advised, but although warned of the possibility of brain complications, he refused to consider it. The

next few days his pain, which had been localized to the mastoid, increased.

He was admitted to the Eye and Ear Hospital December 12, 1910. At this time physical examination was negative. T. P. R. normal, reflexes normal, and no change in the eyegrounds. The next day, under ether anesthesia, a radical mastoid was done. Before the patient left the table a lumbar puncture was made. There was a slight increase in pressure, the fluid was slightly cloudy, first clear. Microscopic examination showed pus cells in abundance and pneumococci. The day following the operation there developed a very marked nystagmus to the right (the diseased side) and slightly rotary in character. This nystagmus with the labyrinthine tests was typical of labyrinthine empyema and cerebellar abscess, as described by Barany. It was decided not only to drain the dura but also to open the labyrinth and explore the cerebellum. There was no Kernig's sign present, reflexes normal, but there was a marked myotonia.

Operation.—Chloroform anesthesia. Enlargement of the former opening. The cochlea, vestibule, and semicircular canals were opened and pus and granulation tissue found in all. The dura over the posterior lobe of the cerebrum and the anterior surface of the cerebellum was exposed and incised and subdural drainage of silk-gut introduced. Considerable fluid drained from both openings. An abscess on the anterior surface of the cerebellum in close proximity to the internal auditory canal was opened and about a dram of pus escaped. Lumbar puncture—40 cc. of spinal fluid was removed and replaced with 40 cc. N. S. S.

Dec. 15, 1910. Nystagmus undiminished. No headache.

For four days there was a decided improvement in the patient. During the twenty-four hours there was considerable drainage from the dura, the amount gradually diminishing. Pus still drained from the cerebellum.

Dec. 18, 1910. Patient seems stupid, complains of severe headache and there is some rigidity of the neck.

Dec. 19, 1910. Patient still worse. Temperature 102, respirations irregular, and delirium. Nystagmus unchanged.

Operation—Further exposure of the cerebellum with a view if possible of getting better drainage.

There was, however, no improvement and the patient be-

came gradually worse. He was delirious most of the time, the temperature was between 101 and 102, and the respirations were Cheyne-Stokes in character. He died December 22, 1910.

Postmortem report by Dr. Willetts:

Report of partial autopsy on body of young male adult. Behind right ear is operation wound in lower part of which drain is still present. Wound partially healed. On opening skull this external opening is found communicating with a small abscess cavity in the right lobe of the cerebellum and also with a smaller pus focus in the posterior and lower part of the right temporal lobe. About this region there is no exudate, but over the entire left lobe of the cerebellum there is marked purulent exudate in the leptomeninges. This exudate is also seen over the base of the brain and extending down in the meninges of the cord.

Cultures were sterile. Body had been embalmed with solution of formalin and this probably accounts for sterile condition.

The following points are of interest:

1st. A beginning meningitis present at the time of operation, with no clinical symptoms other than would be expected from the ear conditions, and but for the lumbar puncture made at that time, could be classed as one caused by operative interference.

2nd. The marked spontaneous nystagmus to the diseased side which continued until shortly before death, as diagnostic of complicating cerebellar abscess.

Barany says that "A diagnosis of empyema of the labyrinth (total destruction) with cerebellar abscess may at once be made, as a spontaneous nystagmus to the diseased side can only be produced intracranially when the absence of caloric nystagmus has shown the presence of destruction of the labyrinth. Meningitis and cerebellar tumors may easily be ruled out of the diagnosis by the other symptoms."

3rd. The extent of the influence of early subdural drainage on meningitis, as shown at the postmortem.

CASE II.—H. E., age 18, white, Hebrew, was admitted to the Eye and Ear Hospital September 26, 1910, complaining of pain in the right ear and mastoid. He gave the following history: Following going in swimming six weeks ago, he

had the symptoms of acute purulent otitis media. The ear discharged freely, but in the last few days he had suffered severe pain in the right side of his head.

Examination—Ear: Swelling back of the right ear in the mastoid region and below in the neck. The swelling is hard to touch, no fluctuation and is very sensitive to pressure. There is profuse discharge from the ear.

General examination—Negative as to physical signs. The patient is poorly nourished and has an old apical lesion.

Urine analysis negative.

Blood examination—W. B. C. 15,000. Polys. 87, Lymph. 12, large Mono. and Trans. 1%.

Pus examination—Pus showed diplococci, Gram positive.

Sept. 27, 1910. Mastoidectomy by Dr. Waldie. Necrosis was complete, pus being present in quantities. The tip was removed. During the operation the lateral sinus was accidentally opened. There was a free flow of blood.

October 3, 1910. Temperature shows but little improvement. Swelling in the neck better. Complains of no pain in his head.

October 4, 1910. W. B. C. 11,000. Polys. 85, Lymph. 12, Trans. and Large Mono. 8. Temperature 105.

October 5, 1910. Operation by Dr. Day. Lateral sinus opened, a septic clot removed. It extended from about two inches beyond the knee of the sinus to the jugular bulb, including the latter. The jugular bulb was opened and curetted. No return flow was obtained from the bulbar end. Jugular vein was ligated and resected.

October 8, 1910. W. B. C. 11,400. Polys. 81.

October 13, 1910. No change. Photophobia.

October 14, 1910. Patient delirious all day. Marked myotonia. Knee jerk not increased, no clonus, no Babinsky, possible Koernig's.

Spinal puncture with withdrawal of 20 cc. of quite turbid fluid which examination showed to contain numerous pus cells. Eye grounds negative. W. B. C. 15,000. Polys. 77.

The diagnosis of meningitis was made but no operation was performed at this time because it was impossible to get the consent of the boy's parents.

October 15, 1910. General condition improved. Delirium has given place to rationality. Koernig's negative. Spinal

puncture with removal of 20 cc. comparatively clear fluid, which was found to contain pus cells and streptococci.

October 16, 1910. Again delirious. Pulse dicrotic. Lumbar puncture—30 cc. of turbid fluid removed. Temperature 105.

October 17, 1910. Koernig's positive. Numerous rales (toxic bronchitis).

October 19, 1910. Subdural drainage by Dr. Day. Drainage inserted both above and below the tentorium.

October 21, 1910. No improvement. Died 6:30 a. m.

Report of partial autopsy on young Hebrew at Eye and Ear Hospital. Postmortem by Dr Willetts:

External examination of head showed operation wound behind right ear with drainage in lower end of wound.

Examination of brain—Opening through skull into crainal cavity on right side behind petrous portion of temporal bone, above and below the tentorium. The surface of brain immediately in contact with the drain and for a considerable area about it is perfectly clean and smooth with no visible exudate. The lateral sinus was empty and smears made from this and also from jugular bulb and sigmoid sinus showed no pus or bacteria.

Over the entire surface of the brain except this area mentioned above, there was a fibrinopurulent exduate within the leptomeninges This exudate extended into the meninges of the cord as far as could be seen through the foramen magnum. Smears made from the meningeal exudate showed typical streptococci.

Pathologic diagnosis—Diffuse fibrinopurulent leptomeningitis involving all parts of the meninges except an area on right side over right cerebelar and temporal lobes, where drain was applied.

Brain edematous. General purulent leptomeningitis with some fibrinous exudate over both hemispheres, except in the region of the drainage. The temporosphenoidal lobe of the cerebrum and cerebellum were comparatively clear.

While the dural drainage was undertaken too late in this case to hope for recovery, the postmortem findings, taken with the preceding case, show what can be expected from it:

1st. Dural drainage is effective over a limited area, but extends some distance beyond the drain.

2nd. That these dural areas were found at the postmortem comparatively normal. This is probably from the fact that the dural drain is most active at first and ceases after 36 to 48 hours, probably caused by the blocking of the arachnoid spaces leading to the drained area, which also protects it from re-invasion.

3rd. That to be effective in general meningitis, many drains on both sides of the skull would be necessary. Without having had an opportunity to test it, lavage of the cerebrospinal sub-arachnoid spaces, as proposed by Barr, appeals more strongly to the writer.

XXIV.

SOME RAMBLING THOUGHTS CONCERNING THE RADICAL MASTOID OPERATION.

By Frank Allport, M. D.,

Chicago.

I wish it to be distinctly understood that this paper, or whatever you may choose to call it, is in no sense to be considered in the light of a scientific dissertation. It is merely a gossipy talk on certain aspects of mastoid work, which have been gathered and stored away in my mind since my last published utterance on mastoid surgery some years ago. I am adhering to my old methods in some instances, and in others have abandoned them and am working along different lines. It will be my purpose in this rambling talk to discuss these various aspects of my work and to try to explain why I adhere to the old methods, or why I have come to substitute new ones.

Let us first consider

THE INCISION.

I still make a long curving incision, beginning at the extreme limit of the mastoid tip, and curving around and close to the base of the auricle, and over the auricle to a point directly above the external auditory meatus. (It should be of course understood, that I am talking now about the radical operation). The incision should not be so close to the auricle, as to cut open its lumen, and ample tissue should be left for the insertion of sutures. This incision long as it is will sometimes have to be enlarged downward if much work in and around the tip cells has to be done, and upwards and forwards if much zygomatic disease becomes disclosed. I think it is foolish to try to complete the entire depth of the incision in one sweep of the knife. It is not easily accomplished, and such efforts will usually be accompanied by the production of a ragged and torn periosteum. I think it is better to carefully outline the incision by a comparatively gentle sweep of the knife, as its exact and proper location can in this way be better desig-

nated than by an effort at a single primary incision. This incision should be quickly followed by a second, which will lead us to the periosteum, which should then be carefully incised through to the bone, with as little laceration as possible. Unless the hemorrhage is violent I do not bother with artery clamps, for by working quickly, I soon have my self-retaining retractors in position, and then all flap hemorrhage ceases. After the incision is completed, the soft tissues, including the periosteum, is quickly shoved back by a periosteotome, and the adherent tissues at the mastoid tip are cut away by curved, blunt, strong scissors. The retractors are now placed in position, one pair in the upper end of the wound, and another pair in the lower end of the wound, and screwed up to their utmost capacity for expansion.

THE SELFRETAINING RETRACTORS.

The teeth of the two pairs of retractors should not touch nor interlock, as this limits the usefulness of both. The wound should be long enough to freely accommodate both pairs of retractors. This is one reason why I curve my incision around the upper portion of the auricle, and I have never found that cutting a little into the muscle at this point did any harm, or produced any drooping of the auricle. As I have said, the retractors should be screwed up to their fullest capacity of expansion. This is necessary for several reasons. In the first place it is only by such extreme pressure on the tissues that hemorrhage ceases. Partial expansion, I verily believe, produces hemorrhage, and I would rather not use the retractors at all, than to use them partially expanded. It is for the purpose of adding strength and forcefulness to these retractors that I have had the latest models made heavy and strong. The screw head in the old models used to be round, but I found that it was quite impossible to produce much power in a round screw head, especially when the hands are moist, as they always are doing an operation. I therefore had the screw head made flat, so that the arms can be easily spread apart to their utmost capacity, if the wound is at all long enough. The teeth of the retractors should be placed under all the soft tissues, and firmly held there until the arms are fully expanded. With a good long incision, with the two pairs of retractors properly placed, and with the blades fully expanded, there seems little

left to be desired in the way of a bloodless and ample field of operation.

I do not make the backward incision, as practiced by Whiting and others, because by the procedures just described I do not need it, and consider it to be a needless incision, the field is ample without it. Of course, if I intended entering the cerebellum, or the backward course of the lateral sinus, I would doubtless make this incision, but not otherwise, except in extreme cases of backward necrosis. It sometimes happens that the tissues are so stiff and swollen that the retractors cannot at first be expanded to their fullest capacity. In this event, we must do the best we can at first, but little by little the retractors will become loosened in their position, and must from time to time be tightened by twisting the screw head, it being remembered that the retractors, in order to fulfill their real usefulness, must always be kept tightly and firmly in position. Otherwise, they simply "wabble" around in the incision (if I may use the expression), perhaps drop out, and instead of being of use, are really a nuisance. I cannot understand why everybody does not use these retractors. I do not say so because I devised them, but, properly used they are so manifestly helpful, that I cannot see why operators persist in ignoring them and in adhering to the old hand retractors. Hand retractors require another person, and another pair of hands around the patient's head. They cannot compare with the selfretaining retractors in the firmness and constancy of their expansion; they do not control soft tissue hemorrhage; they do not provide a constant and complete view of the operative field; they are hard on the assistant who holds them. This very day, as I am writing this communication, I saw an experienced and skillful nurse faint completely away, from the sheer fatigue of the long holding of hand retractors. And let me urge, that if you are going to use selfretaining retractors, that you use only modern models, and that you use them properly. I have been asked if my retractors do not injure the meatus. I can only reply that I have never seen such an occurrence. In the radical operation it does not make any difference anyway, because the meatus is subsequently cut in making the flaps, and in the acute operation, if the meatus is squeezed together pretty tightly, the trouble can be easily remedied by packing the meatus with gauze after the operation

is finished, to thoroughly keep its walls apart, a precaution which I notice most operators take anyway, whether they use hand or selfretaining retractors.

After the retractors are in position, the posterior, superior and inferior walls of the cartilaginous meatus should be liberated from the underlying osseous meatus, by passing a small spatula, or something of this nature, between the two structures. If it looks as if the cartilaginous meatus was going to constantly project into the field of operation and annoy the operator, a strip of gauze should be passed through the cartilaginous meatus inwards and brought backwards and the two ends brought tightly together by an artery forceps. This forces down the posterior wall of the meatus, and keeps it out of the way. If this is going to be done the retractors will have to be temporarily removed, the gauze inserted, and the retractors replaced. The retractors will hold the gauze firmly in position after they are replaced. Some operators always insert this strip of gauze and I am not at all sure but this is a good plan. I am more and more inclined to think it is. If this plan is to be followed, the gauze should, of course, be inserted before the retractors are inserted at all, and the cartilaginous and osseous meati should also be separated before the gauze or the retractors are placed in position.

THE CHISELING.

The primary danger in removing the mastoid cortex is, first, the exposure of the sigmoid sinus, especially if it is abnormally placed, and, second, the exposure of the dura of the temporosphenoidal lobe of the brain. The mere exposure of these membranes really does no harm, but it should not be forgotten in opening and working upon the mastoid bone, and should be avoided if possible.

The exposure of the dura as an initial event in chiseling can only be accomplished by chipping out a piece of bone much higher than we have any business to be working. Except in rare instances the middle lobe of the brain does not lie below a line drawn on a level with the roof of the bony meatus. We should never, therefore, begin chiseling above this line. After we have gotten into the bone, and are familiar with its interior landmarks, we will often be able to extend our bone work above this line, especially where the zygomatic cells are

affected, but we should never begin chiseling at a point above this line. By observing this rule we will never expose the dura as a primary accident, although this membrane is often uncovered either intentionally or accidentally later on in the deeper bone work.

The sigmoid bend of the lateral sinus is not infrequently situated too far forward, or too close to the cortex, especially in young subjects. In removing the cortex, therefore, we should be careful that the chisel does not sink into the bone very deeply, until we are sure as to the location of the sinus.

From time to time temporal bones with peculiar shaped meati will be seen, that are liable to produce incorrect ideas as to their interior anatomy in the mind of the surgeon. The bones I have in mind have peculiar receding or shelving shaped meatal orifices. The posterior margin of the bony meatus does not come up sharply and somewhat perpendicularly to its position, as it should, but recedes backwards and somewhat upwards, giving the impression of a meatal margin much farther backwards and upwards than is harmonious with the interior anatomy of the bone. If we take the actual external meatal margin as a guide for operating, therefore, in such cases, we would operate much higher up and much farther back than we should, and would therefore be quite likely to open the brain and sigmoid sinus. In such cases we should carefully examine the outlines of the inner meatal walls, and from such calculations begin chiseling where the meatal orifice should be. Such calculations would find us chiseling anteriorly to the actual meatal orifice, in its beveled or shelving surface. I have never seen this point described, and have had some difficulty in expressing myself, but hope I have made my meaning clear. I have verified these warnings in quite a number of instances, and have never found them to fail.

I use a large, broad chisel in beginning my work, and in fact I may say that I always use as large a chisel as possible. Of course, as we proceed inwards, the width of the chisel must diminish, but I am confident that a broad chisel is much safer than a narrow one. I rarely use a square end chisel, as I believe that a rounded one is much safer. I use a large metal mallet, with a wooden interior. I am still looking for an ideal head light, one that is simple, does not get out of order, and one that does not become hot.

There are many ways of beginning chiseling procedures on the mastoid cortex, all of them used by thoroughly good surgeons, and all of them evidently performing satisfactory service to those who employ them. Most operators begin in the upper portion of the bone and work down, but others begin down and work up, while still others begin at the posterior surface of the mastoid process, and work towards the meatus. I know one distinguished otologist who makes a dainty little abrasion in the mastoid cortex, with a chisel and hammer, for the purpose of giving his rongeur a start, an d then laboriously completes his operation with rongeurs and curettes. He is afraid to use a chisel and hammer, for fear that the blows will produce a meningitis or rupture a possible encapsulated abscess. Personally, I have no belief in this view, as I have never encountered such a condition, and it would seem as if he was putting himself to lifelong inconvenience and labor to avoid something which he will probably never meet.

I do not believe it necessary to bother with mapping out McEwen's triangle, or any other landmark; simply do not begin chiseling above the meatal roof and keep close to the posterior wall, and as a rule trouble will be avoided. Personally I believe it best to observe the rule just mentioned, and to peel away long strips of the cortex with a broad chisel, until the interior of the bone is well exposed, meanwhile never allowing the chisel to sink into the bone too deeply or too far back. After the mastoid cavity is exposed I immediately begin breaking down the posterior bony meatus. This has to be done anyway, and by doing it early in the operation we are enabled to work farther forward, as more room is obtained and there is less liability of injury to the sinus. I remove then the posterior wall of the bony meatus at the same time that I remove the other contiguous bony structure. The posterior portion of the mastoid interior and cortex is beveled away with the broad chisel, the edge of the chisel being directed toward the meatus continually, instead of either down or up, as held by many surgeons. The chisel should not be allowed to sink deeply into the bone, for fear of injury to the sinus.

The bony opening should extend downwards to the tip, which it may be necessary to remove in some cases. The posterior meatal wall should be removed down to its very base, in its one-third outer or external portion, so that practically no

ridge of bone can be found between the floor of the meatus and the floor of the tip cells. The facial nerve does not extend into this portion of the posterior meatal wall and it can be therefore smoothed down until it is practically on a level with the surrounding bone tissue. A little further in, however, the meatal wall must be handled with great circumspection, for within its structure runs the much-to-be-feared facial nerve. I believe that the upper portion of the posterior meatal wall, or the "bridge," as it is sometimes called, can be best broken down by very careful chiseling work. I have tried various instruments for this purpose, and have finally come to depend more upon the chisel than upon anything else, but the work must be done under good illumination and with great care. I wish to say that I also think very highly of the small curette for breaking down this upper portion of the "bridge." Before this is done, however, we should make room for it by chiseling away the extreme upper portion of the bony meatus and posterior meatal wall so that the roof of the newly made cavity is on a line with the tegmen tympani and tegmen antri. By thus working in a freely open cavity, with plenty of room and good illumination, there will be but little danger of injuring the facial nerve in removing the "bridge" and throwing the whole thing into one large cavity. We should never forget that the facial nerve runs across the extreme upper posterior portion of the tympanic cavity proper, but does not get into the attic at all. We should, therefore, always work up, up, and by so doing we will go a long way toward avoiding danger. In thus working up we will sometimes expose the dura, but I would rather do this one hundred times than injure the facial nerve once.

After the "bridge" has been removed and we can freely pass a hook from the attic to the antrum without interruption, we can lay aside the chisel and hammer and pick out the malleus and incus with forceps and curette without much difficulty, provided one or both of them have not already been absorbed. The middle ear should be very gently curetted for the removal of granulations which produce constant and annoying hemorrhage, and we are now ready for the interior work on the bone. This is done by most operators by rongeurs and currettes, indeed a great deal of the work already described is accomplished by a majority of operators by rongeurs and

currettes, but I find it more rapid and convenient to do it by chisel and mallet. The work upon the interior of the bone I perform with electrically driven burs, of which I have a considerable assortment, some olive shaped, some round, some almost smooth, some large, and some small. Before leaving the subject of chiseling and curretting I wish to say that I believe we are all too careless in looking after the condition of these instruments. In order to do good and rapid work our chisels and curettes should be kept sharp. It is astonishing how much easier and more delicately we can work with instruments having keen cutting edges, and yet I think most of us are very negligent on this point.

THE USE OF THE BUR.

I cannot understand why the bur is not in quite general use, for, after many years of experience with it, I can frankly say that I consider it the best, quickest and safest instrument for cleaning out the interior of the bone. Of course, the operator must have a reliable and powerful motor, a strong and bendable cable (a second cable, with handle and a second foot "cut-off," should always be on hand in case of a breakdown), a satisfactory handle and a proper assortment of burs capable of working in all sorts of cavities. I use a foot "cut-off," so that when I press the knob with my foot the bur revolves, and when I take my foot off, it stops. I always work with an aseptic cloth sleeve drawn over the cable, so that I have no fear in handling it. The handle itself can be sterilized. In the motor which I use, the speed of the revolutions can be controlled by a handle. When using a bur I do not attempt to hold the handle gracefully in one hand; the machine is too powerful for this, the bur would jump from place to place under such circumstances. We must have the bur under complete control in order to make it safe. I therefore hold this handle (down close to the bur) with both hands. My elbows are usually steadied against my body, and hands are steadied against the head of the patient. If these precautions are observed, the bur can be used with perfect safety, and it will not jump. I know of no instrument that can be used so efficiently and safely in delicate places, such as around an exposed dura, sinus, facial nerve, or horizontal semicircular canal; and as for smoothing off overhanging bone, cleaning

out mastoid cells, "rimming out" the eustachian tube, beveling down the floor of the meatus, smoothing down the posterior wall of the meatus, cleaning out the aditus, and shaping up the cavity in general, and getting out all necrosed tissue, there is no instrument or group of instruments that can at all equal it. But I always say to a surgeon who intends using this instrument, not to be discouraged if he does not like it at first. He must know how to use it, and in order to do this he should not discard it until he has used it twenty or twenty-five times. After he has done this, he will have become an enthusiastic advocate of the bur for mastoid work.

While using the bur the cavity should be frequently washed out with warm sterile water, driven by a powerful syringe, as great masses of bone dust accumulate, and unless washed away and would obstruct our view and impede progress.

The bur should be frequently cleaned by a nurse, as its teeth become filled with bone dust and do not cut well. The bone should be kept moist, either with blood, water or adrenalin, as otherwise the bone and bur become overheated and superficial bone necrosis may follow. I have had a number of these cases, where the first dressings were absolutely black and very foul smelling, but in these cases I have dressed the patients daily with powerful antiseptic douchings and powders, and in a few days this complication has passed away, and I have never seen any unfortunate consequences follow.

I take down all of the posterior meatal wall that I possibly can without injuring the facial nerve. The outer portion of the wall, perhaps the outer third, can be removed entirely and beveled down so that it is on a level with the contiguous bone. As we progress inwards, however, we must remember that the facial nerve is contained within its structure and too much bone must not be removed.

As we bur into the meatal wall in this vicinity, on its edge, we will occasionally see a little bleeding artery making itself manifest. This is the artery which accompanies the nerve, and when seen should be a signal to us to desist from further work in this vicinity.

The remnant of the meatal wall should be burred down with a fine bur, so that there are no rough places, nor elevations on it, and the floor of the meatus should be leveled down, so that there is no obstruction to good drainage. I think that

almost all of these cases should be cleaned out way down to the tip cells, and every suspicious place, whether in the mastoid bone proper or in the zygomatic region, should be investigated by the bur and thoroughly cleaned out. When we are through operating we should have produced a large cavity without any overhanging edges, and with every place in the bone looking smooth and healthy. The two hardest places to heal over, in my experience, have been the extreme innermost portions of the antrum, and the aditus ad antrum, but if these are thoroughly polished with suitable sized burs they will heal as rapidly as any other portion of the cavity.

THE EUSTACHIAN TUBE.

I take great pains to thoroughly clean and curette the eustachian tube, as many cases are apparently uncured, when they are entirely well, save for a more or less constant dripping from the tympanic orifice of the eustachian tube. For this reason I think that all of these cases should have all diseased tissue removed from the throat. I mean particularly such conditions as diseased tonsils, adenoids, and granulations or adhesive bands in the fossæ of Rosenmueller. Apparently uncured cases will sometimes be promptly relieved by a removal of such pathologic conditions. At the time of the mastoid operation, it is not sufficient to merely curette away granular tissue from the eustachian tube. It is necessary not only to do this, but to scrape the superficial bone tissue, so that an adhesive inflammation may be produced, which will actually close the mouth of the tube. This I accomplish by curetting the tube and burring out its orifice by hand and electrically driven burs. I am usually able to pass the curette and hand burs down into the lumen of the tube as far as the isthmus, but the electrically driven bur I only hold at the opening of the tube, in order to thoroughly "rim" out the aperture. I am not unmindful of the fact that the carotid artery lies close to the eustachian tube, and there is danger of injuring it. However, I always force the working end of the bur or curette forward and upward and have never had an accident. A distinguished friend of mine has, I understand, ruptured the artery twice, and has been able to control the hemorrhage by tight packing in the tube, but I doubt if we would all be as lucky as this. Our work then in the eustachian tube, while it

should be thorough, should at the same time be cautious, remembering always to work forwards, instead of backwards. Sidney Yankauer of New York City, has lately devised some eustachian tube curettes, for the purpose of curetting the tube, and possibly preventing a mastoid operation. These curettes I have used several times while making a radical mastoid operation, and have found them very efficient in curetting the tube. I would also suggest that these instruments might prove useful in adding the last touch to the after treatment of cases, following the radical operation, where a discharge persists that probably is tubal in character. The work under such circumstances would, of course, be performed through the meatus.

THE FLAP.

I have nothing to say against any good flap, but personally I prefer a modification of the Panse flap. The original Panse flap was made by making a vertical incision in the concha, and a horizontal incision throughout the length of the cartilaginous meatus, thus producing what might be termed a T flap. The upper portion was attached upward and the lower portion downward, the intention being to commence a dermatizing process in both the upper and lower portions of the new bone cavity.

I make my flap as follows: I use a lance shaped knife to penetrate the concha. I penetrate from before backwards, in order to be sure where the penetration occurs, as it is desirable to produce as large a meatus as is possible to be consistent with a lack of deformity. This can be accomplished by setting the conchal incision as far back as possible; hence the care in making the original penetration. After this incision has been made, and before the knife has been withdrawn, I pass alongside of it a blunt-pointed bistoury knife, from behind forwards, and then withdraw the lance-shaped knife. The new knife is blunt pointed, so that it will not prick the surrounding tissue, and is curved backwards, so as to more easily get into the corners of the conchal incision. The conchal incision should not be vertical but curved in outline, so as to more thoroughly conform with the natural shape of a meatus, and should extend as high up and as low down as possible.

After this has been done, I insert my divulsors into the

meatus, from without inwards, and stretch the cartilaginous meatus to its fullest capacity. I then insert the dull-pointed bistoury knife into the meatus at its inner extremity, and, using the lower blade of the divulsor as a guide, I cut out the meatus up as far as the conchal incision. I throw the entire meatus into the upper flap, because I find that the upper portion of the opening is the only place I ever have any trouble in dermatizing. You will see that I make an L, rather than a T shaped flap.

I usually take out considerable cartilage, especially if it shows a tendency to protrude, as by so doing the flaps fall into place better, and I think there is less danger of perichondritis, which I have had once and never want again. I attach the upper corner of the meatal flap to the soft tissue, in the temporal region, underneath the skin, by a single catgut suture. There really is no lower flap and consequently no suturing is here required.

The cavity is packed with xeroform gauze, smeared with sterile vaselin, to mitigate the pain of the first dressing. I still use the Michel metal sutures, and after they are all in, I crowd the meatus as full of gauze as possible, in order to assist in expanding the entire opening, and especially the meatal orifice.

I have purposely adhered in what I have said, to an ordinary, uncomplicated, radical mastoid operation. The discussion of complications would far overrun any ordinary space that might be given me.

THE DRESSINGS.

The dressings are removed on the third or fourth day. They should be removed with much irrigation, and absolutely without force, lest the repair process should be interfered with. If force proves to be necessary, the packing should remain and be removed at a subsequent dressing. Every alternate suture should be removed at the first dressing, and the remainder in two or three days' time. Formerly, I was much in favor of the continuation of gauze dressings until the end of the case; but now I am not. I believe that after the outlines of the new cavity have been defined, that packing had better cease, and the cavity had better be practically completely filled from dressing to dressing with powdered boracic acid. This keeps the parts clean and does not interfere with the formation

of new tissue. It can be easily washed away without violence. The dressings can be gradually decreased in frequency, as their necessity diminishes.

Granulations but rarely occur. Should they present themselves, however, they can be curetted or cauterized with trichloracetic acid.

My cases are usually healed in from eight to ten weeks. They are only in the hospital for about two weeks, after which they become office patients.

THE HEATH OPERATION.

I have not changed my mind concerning the Heath operation, unless I might say that I think less and less of it as time progresses. I have never had any personal experience with it, but have observed the work of others and have reoperated a number of cases previously operated by some of my fellow surgeons, that were utter failures when operated by the Heath method, and were entirely cured by the regular, radical mastoid operation. Of course, I realize that some of my friends may have reoperated my failures and achieved success, but the Heath operation never has and never can appeal to my sense of proper surgery. He leaves practically untouched the diseased middle ear, and the diseased attic, which in my opinion are usually the foci of all the trouble, especially the attic. His method is really not much more than an elaborated simple mastoid operation, and he hopes with an optimistic (but not surgical) mind, that the large opening and the drainage will cure the disease. I do not believe that this hope is safe, sane or surgical, and I therefore cannot espouse it, and would not advise others to. If the tympanic space, including the attic and the antrum, are diseased and necrotic, I think there is but one method to cure this condition and place the patient out of danger, viz., by means of the radical mastoid operation. All other procedures are temporizing in their nature, and are usually the result of timidity, fear, or improper ultraconservativism.

GRAFTING.

As a rule I do not graft at all, as my cases are healed in from eight to ten weeks. If unhealed areas are present by this time, I cover them by small pieces of thin skin, which usually

hastens healing. But I do this very seldom. As is well known, Ballance opens his postauricular opening in seven or eight days after granulations on the bone have had a chance to form and covers the entire area with a single large skin graft, held in place by small pledgets of cotton, after which the wound is reclosed. He claims that this materially shortens the healing process; but the patient has to undergo two operations and take anesthesia twice. This is certainly a serious objection to the plan.

Dench of New York has for some years made primary graftings, that is, grafting made at the time of the original operation. For a long time I was opposed to this process, believing it illogical to suppose that grafts would adhere to freshly chiseled bone. I have, however, lately had the opportunity of seeing Dench do some of this work, and of seeing some of his results, and of talking with those who are in a position to know the results, and I have been convinced that it is a good thing, and should be more extensively used. I know of one of his cases that was dismissed cured in two weeks, and certainly nothing that I, at least, can show can at all equal this. He ties all the bleeding arteries, uses a good deal of adrenalin, and waits until there is little, if any, hemorrhage. He then slips into place a large, thin skin graft, and patiently coaxes it into place. He sucks out blood, air and liquid under the graft by a mouth suction pump with a curved glass pipette attachment. This suction also assists in accurately conforming the graft to the cavity. When it is in place he holds it down by little wads of cotton sprinkled with aristol. They are applied loosely. An account of their number is recorded, so that he will know later if all have been removed. The postauricular wound is then closed, and another graft is applied into the external meatus, to heal these parts quickly. Packing is then loosely applied into the cavity, and the regular bandage applied. The first dressing occurs in about five days, and from then on regular dressings are made until the complete healing occurs. I would suggest that a general and repeated trial of this method be made, for one of the grave objections to the radical mastoid operation is the tedious after treatment.

XXV.

FOUR CASES OF FOREIGN BODY IN THE ESOPHAGUS REMOVED WITH THE AID OF THE ESOPHAGOSCOPE.*

By Sidney Yankauer, M. D.,

New York City.

Case 1.—A child 3 years old was brought to Dr. Mayer's clinic in Mount Sinai Hospital with the statement that a week previously she had swallowed a penny. There was some difficulty in swallowing, but fluids could be taken. The fluoroscope showed the presence of a round foreign body just above the sternal notch. The patient was placed upon the table, and without administering any anesthetic a short Killian tube was passed. As soon as the instrument reached beyond the cricoid the edge of the penny was seen, covered with mucus and particles of food, it was seized with forceps, and as it offered no resistance was withdrawn with the esophagoscope. There were no symptoms of any kind afterwards.

The case illustrates how inoffensive a relatively large foreign body may at times be, and how simple a matter may be its removal.

Case 2.—On September 1st, 1910, a child 14 months old was brought into my office with the history of having swallowed a metallic toy, a figure of a rooster. A shadow of the foreign body had been seen with the fluoroscope at the level of the sternal notch. Under ether anesthesia the esophagoscope was at once introduced and the foreign body found and grasped with the forceps. It was readily removed. There was no abrasion of the esophageal walls, even though the foreign body was made of lead, measuring 6 by 15 by 21 mm., irregular in shape, with pointed ends and projections.

This case illustrates that even a heavy, pointed metallic

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body, when promptly removed with the esophagoscope, may be entirely free from serious consequences.

CASE 3.—Toward the end of August, last year, a boy 2½ years old, swallowed a penny. At first he complained only slightly of difficulty in swallowing, but as this difficulty increased he was taken to a laryngologist, who inserted his finger into the esophagus and felt the penny. Not having an esopghagoscope at hand, he inserted a curved forceps alongside his finger and grasped the foreign body. It offered so much resistance that he did not consider it wise to force the extraction, but referred the case to me for esophagoscopy. On the fourth day after the accident, I placed the patient under anesthesia, introduced the esophagoscope, and found the penny at once, just below the cricoid. About one-fourth inch above the penny there was a small abrasion of the posterior esophageal wall, covered with exudate, and apparently superficial. When the penny was seized in the forceps it offered no resistance whatever, and was easily withdrawn. The child had a temperature of 100° F. at the time, but this became normal on the following day, and there has been no difficulty in swallowing or other symptoms since.

It is possible that the resistance to removal offered by the foreign body at the first attempt was due to the fact that the forceps, which was introduced blindly, grasped the mucous membrane, a conclusion which seems warranted by the finding of a small abrasion above the penny, at the time of the esophagoscopy. If so, the case illustrates clearly that a foreign body, otherwise harmless, may become serious when any attempt to remove it is made other than under the direct guidance of the eye.

CASE 4.—In contrast with the above, the last case illustrates the extreme danger to which the swallowing of a foreign body may subject the unfortunate victim.

The patient was a boy 4 years old, who swallowed a piece of brass on December 6th, 1910. The piece of brass had somewhat the shape of a truncated cone, the larger diameter being 17 mm., the smaller 6 mm., the height 8 mm. The edge of the smaller diameter was turned over in the form of an irregular burr, having an exceedingly sharp edge.

The patient was admitted to the St. Joseph Hospital in Paterson, N. J., where a radiogram showed the presence of the

round body just above the sternal notch. The child could swallow with difficulty, the temperature was 100°. An esophagoscopic examination was immediately made by Dr. Atkinson, who states that although he was able to pass the cricoid and enter the esophagus, the passage was obstructed by a whitish mass, which was soft to the probe, and which was stretched across the opening of the esophagoscope. The foreign body was not seen. On the next day, December 8th, swallowing better; temperature, 99 to 100. Radiogram shows foreign body in same place; slightly different position.

On December 9th, Dr. Atkinson did a second esophagoscopy with the same rseult. Temperature, 99 to 100. On December 10th I saw the case in consultation with Dr. Atkinson. As soon as the esophagoscope reached the level of the cricoid cartilage, I could see that there was an extensive wound of the posterior esophageal wall, about as large as a quarter. It was covered with a whitish exudate, of which I removed as much as I could. When the tube was advanced beyond this area it entered a narrow channel, which opened and closed with respiration; but as the tube could be advanced beyond the point where the foreign body lay, as determined by measurements taken on the radiogram and on the patient, without bringing it into view, I decided that I had entered a fistulous tract behind the esophagus. There was no bleeding. As the esophagoscope was withdrawn, a careful search was made for the lower edge of the opening into this fistula, by following its anterior wall upwards, but it was not found until the moment when the tube passed out above the cricoid. A further examination of the wound was now made, and it could be determined that a right-angled wound existed, running horizontally across the esophagus from left to right, and extending down the right side for a distance which could not be ascertained. An attempt to get over the upper edge of the flap by drawing the cricoid forward, resulted in causing a spasm of the larynx, so that the patient became deeply cyanotic. The tube was withdrawn, artificial respiration done, and oxygen administered. When normal respiration became established, a second attempt was made, which resulted in the same way. I then tried to depress the flap by inserting a probe through the tube, but for the third time the operation had to be discontinued and the patient resuscitated. I de-

cided to make one more attempt, and passed the tube down along the left side of the pharynx, keeping close to the back of the tongue, so as to get over the flap at its base. This maneuver was successful; the tube entered the esophagus, the foreign body was seen and grasped with the forceps, and as it offered no resistance, it was withdrawn with the tube.

I did not see the patient afterwards. Dr. Atkinson reports to me that the patient rallied from the operation, but could not swallow and had to be fed by rectum. On the second day after the operation the temperature rose to 103 3/5, the pulse became rapid and feeble. This condition continued until the following day, when the patient died.

XXVI.

TWO CASES OF FOREIGN BODY IN THE BRONCHUS; A CASE OF TUMOR IN THE LOWER TRACHEA; REMOVAL BY UPPER BRONCHOSCOPY.*

By Sidney Yankauer, M. D.,

New York City.

Case 1.—On June 10th, 1910, I was requested by Dr. Coffin to see a boy 4 years old, at the Manhattan Eye and Ear Hospital, who gave a history of having swallowed a pin a few days previously. He was coughing and vomiting frequently; his temperature was 101.6, pulse 150, respiration 36. A radiogram showed the pin extending from the second rib to the fourth interspace on the right side, the point being up and directed toward the median line. A bronchoscope had been introduced and the pin was seen in the right bronchus, but it could not be grasped with the forceps. I introduced the Killian tube, and upon advancing it into the right bronchus the shank of the pin could be seen, but neither the head nor the point could be brought into view. All efforts to dislodge the point of the pin were unsuccessful. I then put a Lister hook around the pin, and by rotating it against the end of the tube I succeeded in bending the pin to nearly a right angle. I then grasped it with powerful forceps at the bend, and extracted it through the tube, completely doubled upon itself. The pin was brass, about 1½ inches long, with a glass head ¼ inch long.

Within forty-eight hours after the operation all symptoms had subsided and the patient could be discharged cured.

Case 2.—On December 16th, 1910, I was requested by Dr. Brewer to see a patient in his service at the Roosevelt Hospital, who gave the following history:

*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society, Boston, Mass., February 4th, 1911.

B. G., female, 12 years old, states that eight months ago, while eating prunes, one of the prune-stones "went down the wrong way." She immediately had such a severe paroxysm of coughing that she was taken to a hospital, where she continued to cough almost constantly for three days. An X-ray plate showed nothing. The cough subsided and she was discharged. The cough soon returned, however, and she was taken to another hospital, where a second X-ray plate proved negative and a bronchoscopic examination failed to reveal the presence of a foreign body. Following the bronchoscopy the cough diminished, and after a week she was discharged. The cough again returned, however, so that the patient sought relief at the Roosevelt Hospital. An X-ray plate at this hospital showed an indistinct shadow in the region of the left bronchus.

Physical examination showed that the left chest expanded 1¼ inches less than the right; the percussion note over this side of the chest was normal, but there was a complete absence of voice, breathing and fremitus over the lower half. Sibilant and sonorous rales were present on both sides. There was mucous expectoration and slight temperature, never above 100° F.

On December 16th I made a bronchoscopic examination under ether anesthesia. Owing to an unusual rigidity of the muscles of the neck, which could not be made to disappear, even under profound anesthesia, some difficulty was experienced in introducing the tube, so that fully 15 minutes were consumed before the larynx was passed. As soon as the tube entered the trachea an immediate search was made for the bifurcation, which is usually the easiest and most distinct landmark in the bronchial tube. This structure was not found at its usual distance from the teeth, and it was not until the bronchoscope had been advanced considerably further that a division was seen, which was immediately recognized as the bifurcation of the right bronchus, and not the bifurcation of the trachea. The tube was therefore withdrawn the left wall of the bronchus searched for indications of the tracheal division. After passing the usual site of the spur two or three times, a white area could be recognized in the posterior half of the left bronchial wall, which I detemined to be a part of the spur, very much swollen and edematous. The tube was

therefore pressed firmly into the left tracheal wall above this area, when a depression could be recognized, which was filled with secretion. This proved to be the swollen orifice of the left bronchus, for when the tube had been advanced about 1½ cm. into the swollen parts, the lumen of the left bronchus suddenly opened out before the end of the instrument, and the foreign body could be clearly seen lying horizontally across the lumen of the bronchus. It was seized with the forceps, and as it was not fixed it was drawn up to the end of the tube. It was too large to pass through the tube, so that the two were withdrawn together.

Convalescence was very rapid; within 48 hours the physical signs and the cough disappeared completely, and the patient has remained entirely well since.

CASE 3.—In addition to these cases I wish to report briefly a case of tumor of the lower trachea which I saw recently with Dr. Mayer.

Margaret I. W., 3 years old, had been suffering eight months from a spasmodic cough of gradually increasing severity, and was referred to Dr. Mayer for diagnosis. Examination of the nose, throat and larynx proved negative; there was entire absence of respiratory murmur over the lower half of the left chest, and radioscopic examination showed a shadow over the same area. Dr. Mayer made a diagnosis of obstruction of the left main bronchus of unknown origin, and took the patient to Mount Sinai Hospital for the purpose of making a bronchoscopic examination.

The child was etherized; when the epiglottis was touched with the speculum, the patient became cyanotic, so at Dr. Mayer's request I introduced a Killian bronchoscope with an etherizing attachment, and found, in the lower part of the trachea, just above the opening of the left bronchus, a cauliflower growth, occupying about two-thirds of the lumen of the trachea, attached to the posterior wall by a broad pedicle and covered with white exudate. It was removed piecemeal with a bronchoscopic forceps. There was little bleeding.

Following the operation the child gradually improved, and now all symptoms have disappeared. The exact nature of the tumor could not be determined by microscopic examination. Serum diagnosis for syphilis and tuberculosis were negative. Full details of the case will be published by Dr. Mayer.

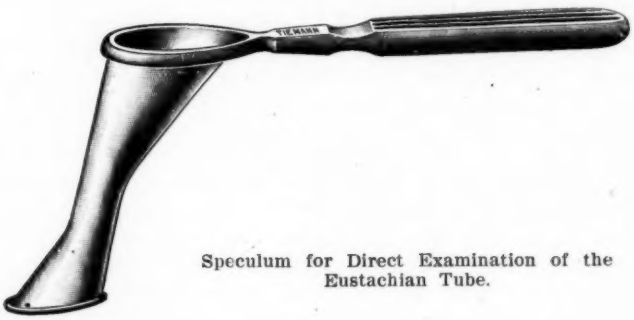
XXVII.

A SPECULUM FOR THE DIRECT EXAMINATION AND TREATMENT OF THE EUSTACHIAN TUBE.

By Sidney Yankauer, M. D.,

New York City.

This speculum consists of a tube of a peculiar shape which is introduced into the nasopharynx, and illuminated by means of the ordinary head-light. It acts as a palate lifter, and as the anterior wall of that part which lifts the palate is on a straight line with the posterior wall of the part which presses



Speculum for Direct Examination of the Eustachian Tube.

the mouth back, it enables us to bring into view the orifice of the eustachian tube and part of its anterior wall.

Its introduction is accomplished by placing the beak under the soft palate, while the body of the tube lies across the tongue, and the proximal part of the instrument rests in the angle of the mouth on the opposite side. The patient's head is held backwards as far as possible, and turned to an angle of 45° toward the side which is to be examined. The use of

*Read before the Section on Otology, New York Academy of Medicine, February 10th, 1911.

cocain is necessary for the first few introductions, but the patients soon learn to tolerate the instrument without gagging.

The first part which comes into view is the vault of the pharynx, then the fossa of Rosenmüller, the posterior lip of the tube, the orifice of the tube, and part of the anterior lip of the tube.

For the exposure of the fossa of Rosenmüller and the posterior lip, cocain may be dispensed with; but to bring the orifice into view the throat must generally be cocainized.

With this speculum it is possible to remove adenoid tissue from the vault or from the fossa with any kind of straight forceps; to cut adhesions which are frequently seen across the fossa; to make applications to the interior of the fossa; to inflate the ear with a straight catheter; to introduce a small tube into the eustachian tube and examine its interior. It is made by Tiemann & Co., of this city.

XXVIII.

MASTOIDITIS WITHOUT APPARENT INVOLVEMENT OF THE MIDDLE EAR.*

By Chas. E. Perkins, M. D.,

New York City.

In cases of mastoiditis we see an almost constantly existing purulent discharge from the ear and changes in the drum membrane, generally associated with narrowing of the canal in its vicinity from swelling of the posterosuperior wall, which here lies over the mastoid antrum. In certain infrequent cases, however, we have these signs absent. I will report briefly four of such coming under my observation.

Case 1.—W. H., male, 51. Came under my care in June, 1908. He complained of fullness in right ear, but entire absence of pain. The drum membrane had its normal luster and color, but seemed to be depressed. Inflation sound appeared to be somewhat moist. On second inflation a few days later this moist element had disappeared, and the ear, so far as one could see, was absolutely normal. One week later he had developed a swelling in the upper wall of the canal at its external extremity. This swelling was not tender on pressure nor did movement of the auricle elicit pain. It continued to grow larger and extended behind the ear, causing it to stand away from the head. Opening of the postauricular swelling evacuated a large quantity of pus, and probe encountered bare bone, thus showing purulent collection to be subperiosteal. So, on July 1st, the patient was admitted to Dr. Dench's service at the New York Eye and Ear Infirmary, and I performed the mastoid operation. The bone was sclerosed throughout, except for one tract of cells extending from the mastoid antrum to the zygoma, which had broken down and formed an external exit for the pus. There was also a perisinus abscess.

*Read before the Eastern Medical Society, New York City, March 10th, 1911.

The patient recovered from the operation and went to work, the wound being practically healed in four weeks.

CASE 2.—S. L., female, age 25, referred by her physician on July 27, 1909, for three months had a small swelling behind the left ear, which appeared just subsequent to confinement. Examination showed a hard, nonfluctuating mass behind and above the ear about an inch in diameter. The auricle seemed to stand away from the head. The external auditory canal, the membrana tympani and fundus appeared absolutely normal. I advised postauricular exploration, and at the Infirmary I operated on the following day and found the mastoid completely broken down, a large perisinus abscess and a large quantity of pus. The tympanic vault was completely walled off by firmly organized tissue, which I did not disturb. Examination of the pus showed infection to be streptococcus capsulatus. The patient made a perfect recovery. At no time was there the slightest discharge from the canal. Wound was completely healed in five weeks.

CASE 3.—R., female, age 2½ years, was brought to the New York Eye and Ear Infirmary in November, 1908, with a swelling in front of the ear, which gave doubtful fluctuation. The swelling was diffuse and occupied the region of the temporal muscle, extending well over to the external angular process of frontal bone. The ear did not stand away from the head. Dr. Dench examined the case and pronounced the external canal, fundus and membrana tympani to be absolutely normal, but decided, notwithstanding the aural condition, to explore the swelling, which proved to be a subperiosteal abscess in the temporal fossa arising from mastoiditis, perforating through the zygoma quite anteriorly. The mastoid was cleared out, and the patient made a slow but complete convalescence.

Case 4 was on the service of Dr. Theo. Janeway, in St. Luke's Hospital, at whose request I examined the patient. Wm. E., age 69, admitted July 25, died July 26, 1910. On June 7th patient began to have pain in his right ear, which remained quite constant. There was, however, no discharge at any time. July 22d, stiffness of the neck appeared, headache and fever came on, with loss of appetite and vomiting. He became unconscious and was sent to the hospital, where he lay comatose; stertorous respiration with twitching and convulsive movements over whole body, worse on right side.

Fluid from lumbar puncture gave short chained streptococcus. No choked disk. I examined him on July 26th, about six hours before death. His left ear was normal. On right side the lumen of the canal was narrowed by diffuse swelling at entrance. The fundus was not contracted, and the color and luster of the drum appeared normal. I advised decompression operation, making a mastoid exploration the first step. Subsequently culture of the blood showed presence of pneumococcus. No operative interference was undertaken. Autopsy showed extensive mastoiditis, sinus thrombosis and general purulent meningitis.

The route of infection in these cases may be through the blood or through the middle ear. In the former case we would have primary osteitis of the mastoid process. This must be very rare, and I believe the usual route of the infection is through the middle ear, notwithstanding the fact that it seems to take so small a part in the process. The infectious material merely passing through the middle ear and not finding conditions favorable to its growth, it produces no apparent symptoms or signs there, and not until it reaches the mastoid antrum, and this becomes walled off from the tympanum by closing of the aditus by inflammatory swelling, does the infective material proliferate and cause breaking down of bone tissue with consequent mastoid abscess.

In case 2 this wall of tissue had become firmly organized, completely separating the middle ear from the mastoid.

In making a diagnosis we are confronted at the outset by the absence of those signs upon which we are in the habit of relying. We can form no judgment from the amount and quality of the discharge, the changes in the membrana tympani and surrounding parts, for in these cases these signs are absent. Spontaneous pain is of very slight value, as it may be due to neuralgia of one of the nerves extending behind the ear. Tenderness on pressure, while much more valuable from a diagnostic point of view, may also be due to unimportant nerve conditions. I have seen cases of neuritis and neuralgia in which the distribution of the pain and tenderness on pressure followed the course of the auricularis magnus or the small occipital. These conditions, as also hyperesthesia over the mastoid, which is not infrequent, must be eliminated before we can attribute the tenderness to mastoid involvement. When-

ever one operates in a case in which the symptom most relied upon is tenderness on pressure, he runs the risk of being disappointed in his findings. How much more so when it is the only symptom. When, however, swelling and edema over the mastoid are associated with the tenderness, and we can exclude other causes, especially furuncle of the canal, we have a clear case, and the mastoid should be explored. So all abscesses and tumefactions in the region of the ear should be looked upon with suspicion. The ordinary subperiosteal abscess, with its characteristic appearance, the auricle standing away from the head, would be easily diagnosed, but it would be more difficult when the pus had made its way anteriorly beneath the temporal muscle, as in case 3, and presence of fluctuation was doubtful. Or the pus might find its way into the neck, giving rise to swelling and tumefaction below the mastoid process, the so-called Bezold's type, or the pus may appear on the posterior wall of the canal and simulate furuncle very closely. After study of the case an exploration of the mastoid may be the only way to settle the matter. If the cause of the enlargement should be discovered before the bone is opened, so much the better. On several occasions I have found the condition to be a broken down postauricular lymphatic node, and I have thereupon desisted from invading the mastoid. When without external signs or symptoms the disease invades the cranial cavity, we are confronted with a most difficult problem. Meningitis, if established by lumbar puncture to be of purulent form, and especially if the organism found is one of those usually causing middle ear suppuration, viz., streptococcus, streptococcus capsulatus or pneumococcus, should direct our attention to the mastoid, and if no other cause can be found, especially in the nose or accessory sinuses, it should be opened either as part of or previous to a decompression operation. In sinus thrombosis we have characteristic temperature, with absence of malarial parasites, and finally positive blood culture, not only justifying operative interference, but making it imperative.

If we have made a diagnosis of brain abscess, located in the temporosphenoidal lobe or the cerebellum, in determining the method of operative procedure, we should bear in mind the fact that nearly all abscesses in these locations are caused from aural infection, and the mastoid should be opened, not

only with the hope of removing the source of infection, but as giving the best possible approach for evacuation and drainage.

In case 4 the presence of narrowing of the external auditory canal near its entrance impressed me with the possibility of this being a symptom of some diagnostic value in some cases. Asymmetry of the two canals with absence of indication of otitis externa would make us suspect the narrower canal, even if the fundus remained of normal caliber.

105 N. Seventy-seventh St.

XXIX.

A CASE OF SPINDLE-CELLED SARCOMA OF THE MASTOID.

By Otto Glogau, M. D., M. U. D. (Vienna),

New York City.

Malignant growths of the mastoid process are very rare and therefore of special interest both from a diagnostic and therapeutic point of view. My reason for presenting the following case is that in reviewing the literature I did not find a similar one reported.

On March 11th, 1910, a man, 45 years of age, was brought into my office in a half-fainting condition.

Previous History.—From his relatives I learned that about the end of November, 1909, he felt pains in his left ear and "his drum was opened." As the pain continued "the bone was opened" two weeks later in the hospital. As no relief was thereby obtained, and the pain now extended over the whole head, "the bone was cleaned out thoroughly" about the end of January, 1910.

Status Present.—Patient is semiconscious, very weak, complaining of severe pains extending all over the head. Respiration 24, pulse 118, temperature 102.8 F.

After removing the dressing covering his left ear, the mastoid and surrounding places presented the picture of a cauliflowerlike mass of exuberant granulations, covered by a yellowish foul discharge. The granulations consisted of lobules from the size of a pea to that of a hazelnut and extended upwards to the level of the superior margin of the auricle, downwards all over the neck to the shoulder, anteriorly to the middle line of the neck and posteriorly, beginning from the mastoid to the middle of the occiput. There was an open wound behind the ear, evidently resulting from a radical mastoid operation. Another wound, beginning in the middle of the above-mentioned and running directly backwards, was

probably due to an exploratory opening of the cranial fossæ. Alongside of the said incisions and in various other parts of the diseased area there were many fistulous openings, through which the probe passed either deeply into the middle ear, or under the subcutaneous tissue, thus showing that the whole area was undermined. There exuded a foul discharge from these sinuses. The external ear was filled by the same kind of granulation tissue, so that it was impossible to introduce a speculum.

The pronounced rotatory nystagmus to the right and the apparent deafness of the left ear indicated to examine the patient for labyrinthine suppuration. However, his condition did not permit of any such tests. It being only six weeks since the radical mastoid operation, the writer could not account for such an amount of excessive granulation tissue and was inclined to believe the condition to be due to a malignant degeneration of the granulating wound. The relatives denied the presence of enlarged glands or of any other swelling around the mastoid previous to the operation.

The mental condition of the patient, together with his pulse and temperature, pointed to an involvement of the meninges. The constant oozing of pus through the mastoid wound made it necessary to locate and eradicate the suppurating focus. Therefore the question as to the malignity or benignity of the granulations had to be settled immediately. I removed a piece of the granulation tissue and sent it into the laboratory for microscopic examination, as it was my firm belief that we had to deal with a malign growth. Another otologist, who had been called in consultation, laid much stress upon the history given by the relatives and pronounced the granulations to be benign; he agreed, however, to postpone any operative interference until the laboratory report was at hand.

I had the patient removed at once into the hospital. His temperature was then 102 F., pulse 118, respiration 24. He complained bitterly of severe pains all over his head, especially pointing to the affected side, was very restless and slightly delirious. At night he got 1/6 of a grain of morphin hypodermically. His temperature rose steadily till it reached, after two days, 104 F. The discharge from the mastoid wound and the fistulous openings became more copious and malodorous. Awaiting the report from the laboratory, the local treatment

consisted of Liquor Burrowi applications and injection of living lactic acid bacilli suspension into the discharging sinuses. On the second day of the patient's stay in the hospital I had the great pleasure of demonstrating the case to my friend and teacher, Dozent Dr. Heinrich Neumann, from Vienna, who just happened to be in New York. Dr. Neumann refused to look at the mastoid wound, saying that the clinical symptoms the patient showed were typically those of meningitis of otitic origin and called for an exploratory operation. He immediately changed his opinion as to operation when I removed the dressing from the mastoid wound and showed him the mass of ulcerating granulations. In his opinion it was a malign growth, probably a sarcoma, and no treatment whatsoever of any avail.

The next day I got the answer from the laboratory. Dr. Goldfrank reported the specimen to be a spindle-celled sarcoma. A blood count was taken and there were found 41,000 leucocytes, polynuclear 89%, lymphocytes 11%. Within the next few days the sarcomatous masses spread, involving the adjoining skin of the neck, shoulder and occiput and encroaching more and more on the meninges, as evidenced by the mental and general condition of the patient. With slight remittances, the temperature kept on being very high.

Although convinced that there was nothing to be done for the patient, it occurred to me to try Dr. Coley's fluid (mixture of streptococcus and bacillus prodigiosus), which was supposed to be of value in the treatment of sarcoma. When I described the case to Dr. Coley over the telephone, he told me that he had seen and diagnosed the case in his hospital and dismissed him as not being suitable for treatment with his fluid; but, still, upon my request, he promised to send me some. When I told the relatives of the patient what I learned from Dr. Coley and asked them why they did not tell me the truth and save me and the patient all the unnecessary trouble to obtain a diagnosis which was already made, they gave me the very characteristic answer: We wanted you to find out for yourself what is the matter with the patient and how his life can be saved. On further inquiry I then learned that the patient had a little swelling back of the ear since quite some time, which started to pain at the end of November, 1909. As the pains were believed to start from the middle ear, he first had his drum opened and later the mastoid.

On March 28th I injected one minim of Coley's fluid into the patient's buttocks. During that day he got ten severe chills. His pulse grew at times nearly imperceptible and became better only after repeated camphor-ether injections. Slight twitching of the facial muscles could be noticed. He complained of excruciating headaches. On the next morning one-half minim of Coley's fluid was injected into the tumor itself. In the afternoon the pulse was imperceptible and could not be improved by camphor injections. Twitching of the eyelids and facial muscles set in, and the patient died a few minutes later in convulsions. Postmortem refused by the relatives.

Epicrisis.—The pains caused by a sarcomatous retroauricular gland were believed to be brought about by suppuration of the middle ear with subsequent mastoiditis and could not be relieved by paracentesis nor by a simple and a radical mastoid operation. Through the operative trauma the latent sarcomatosis of the gland became manifest in causing the postmastoid granulation tissue to degenerate malignly and grow excessively. The process encroached upon the middle ear and destroyed its inner and upper bony walls, thus producing labyrinthine symptoms and meningitis.

It is impossible to decide, if by not operating on the mastoid, the process might have been delayed for a few years; but by removing a piece of the gland and examining it microscopically, the diagnosis might have been established at a time when Coley's fluid could have been given a fair trial.

1184 Lexington Avenue.

XXX.

MASTOIDITIS FOLLOWED BY CEREBRAL SYMPTOMS; RELIEVED BY DECOMPRESSION OPERATION.*

By Charles E. Perkins, M. D.,

New York City.

I. A. F., male, age seven and a half years, came to my clinic at Bellevue and University Medical College on November 29, 1910, with history of having had a mastoid operation one year previously, with wound healing but persistence of aural discharge.

Two weeks before coming under my care a swelling had developed behind the ear and the lower angle of the old wound broke down. On examination, he was found to have a slight swelling over the mastoid with a sinus at the lower part, leading in a direction upward and forward, which discharged a small amount of pus. The ear was also discharging freely.

On the following day, November 30, 1910, at the New York Eye and Ear Infirmary, he was admitted to the service of Dr. Dench and the mastoid was opened. The inner table in the middle fossa appeared normal. The dura was not exposed except for a small area, where it was normal. Patient reacted well from the operation and appeared to be doing well until the second day, December 2, 1910, when at 8:30 a. m. he was taken with a convulsive seizure and became unconscious, and remained so. The movements were practically limited to left side of face and body, and were jerky in character. The eyegrounds showed enlarged veins and swelling of the discs. Uranalysis negative.

A small amount of bloody serum obtained by lumbar puncture under normal pressure gave a negative examination, except three colonies of staphylococci—probably a contamination.

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*Read before the Section on Otology, New York Academy of Medicine, February 10th, 1911.

Blood count, 5,200,000 red; 19,400 white; polymorphonuclears, 89%. Temperature 102. As the patient had become very weak and was rapidly sinking, and evidently passing into a moribund condition, and as the convulsive movements were practically limited to the side opposite the mastoid, an exploration of the brain and decompression operation were decided upon. Thereupon, at 12:30 on Dec. 2, 1910, I proceeded to operate.

The former wound was opened and incision extended forward to about one inch posterior to the external angular process of the frontal bone, and at right angles to this and about three-quarters of an inch from anterior end another incision about one and one-half inches long, thus exposing a large area on the side of the head. The inferior surface of the temporo-sphenoidal lobe was approached by removing the inner table to very near the superior semicircular canal, the superior wall of the external auditory canal and bridge being taken down to do so. Then a large surface of the dura on external aspect of the brain was exposed, working well forwards toward motor area. The dura was then incised by crucial incision, the lower arm of which extended well on to inferior surface to near the superior semicircular canal. The brain appeared normal. Exploration with slender knife to depth of one to one and a half inches in various directions gave negative result. From inferior surface, incision of knife upward and forward for about two inches brought a free hemorrhage, easily controlled by packing the wound. Partial suture and dressing applied.

When the patient emerged from the ether he was free from convulsive movements. The dressings were soaked with serous fluid for about two weeks. Formation of moderate sized brain hernia, which, however, dermatized without difficulty, healing completely in eight weeks.

XXXI.

REPORT OF TWO CASES OF CEREBELLAR ABSCESS WITH THROMBOSIS OF THE LATERAL SINUS; OPERATION; RECOVERY.*

By D. S. Dougherty, M. D.,

New York City.

Cases of intracranial complication of middle ear disease, while not infrequent, are always interesting and instructive, and for that reason, if for no other, the following cases are worthy of reporting:

Case I.—Chronic suppurative otitis media, followed by perisinus abscess, gangrenous thrombus of lateral sinus, and cerebellar abscess.

On Friday, November 8, 1908, I was requested by Dr. L. A. Roos to see Miss S. R., aged 19, who had been under his care, with the following history: Had suffered from suppurative otitis of the left ear for past ten or fifteen years, with almost total deafness on that side for past two years. Had had no serious illness; suffered from astigmatism, and wore glasses for the correction of the same; had occasional severe headaches for two or three weeks, and at times complained of photophobia; had loss of appetite, feeling of tiredness, and occasional spells of vertigo. On the previous Tuesday had paroxysms of earache, and the discharge, which had been profuse, became scanty. On Wednesday was seen by her physician, who prescribed bichlorid douches and the application of an ice bag, and administered calomel. The discharge again became profuse, with pronouncedly fetid odor. Patient fell on attempting to rise from bed. Temperature 99.8°; pulse 96, respirations 22. On Friday had fallen unconscious in bath room.

At ten o'clock of the same day I first saw the patient. She

*Read before Section on Otology, New York Academy of Medicine, February 10th, 1911.

then complained of pain in the left ear and intense vertigo, but was indefinite in regard to the direction of the vertigo. Had had a chill lasting for four minutes earlier in the day, and had just recovered from one lasting half an hour. Was nauseated. Temperature 104; pulse about 140, small and irregular; respirations 24. A thick, foul-smelling discharge was pumping out of the external canal so profusely as to give positive evidence of the involvement of a greater area than the middle ear. There was extreme tenderness over tip and antrum, but no external signs of jugular involvement. Pupils were normal in reaction; slight nystagmus present.

Immediate operation being advised, the family asked for further consultation, and Dr. W. C. Phillips was called and concurred in this opinion. Examination of the pus showed it to be streptococcic. Blood examination showed slight increase in leucocytes but high polynuclear ratio.

The patient having been transferred to the hospital, was operated on at five p. m. She was in bad condition, pulse irregular,—rate from 140 to 160; respirations rapid and shallow. With the assistance of Drs. Mann and Roos, Dr. Gwathmey anesthetizing, and Dr. Phillips being present, the usual mastoid operation was performed. On removal of the cortex an offensive, dark, slimy fluid was disclosed, and the cellular structure of the bone found to be almost entirely destroyed. The antrum was filled with pus, while the dark discharge was traced to a perforation in the bony casement of the lateral sinus, which was necrosed and easily removed with the curette. The walls of the sinus were gangrenous, and a large ragged perforation immediately over the knee exposed a dark greenish-colored clot. This was removed, together with a thrombus of the emissary vein, and the sinus thoroughly exposed and curetted, both backward to the torcula and downward to the bulb, getting a good return circulation in both directions. The patient being in a state of collapse, it was deemed wise not to pursue the operation further. The diseased portions of the wall were removed, and the sinus closed by pressure with the usual iodoform gauze tampons under the bone edges. The wound was then thoroughly closed and dressed. 600 cc. of normal salt solution was infused. Temperature fell to 100.2, pulse to 88.

November 9th to 14th. The patient rested comfortably

except for occasional slight headaches; the temperature ranging between 99.2 and 99.8; pulse 68 to 72 and regular. Differential blood count showed but slight infection.

November 15th. The patient became very restless and complained of chilly feeling and headache. Temperature 101.8, pulse 76 and irregular. Had pain in neck and tenderness on pressure over jugular. No nystagmus, no neuroretinitis. Polynuclear ratio rose from 62 to 80 per cent.

Deciding to resect the internal jugular, Dr. T. P. Berens was called in consultation, and confirmed this opinion. On exposure of the jugular, its coats were found diseased, and it was resected to the clavicle. The mastoid wound was cleansed, and radical mastoid completed.

November 16th to 19th. The temperature remained between 100 and 101°; pulse 104 to 120; patient complained only of pain in back.

November 20th. Became restless and at times irrational. Severe pain at back of head and eyes.

November 21st. Temperature 99.4°; pulse 80. Became extremely restless, very drowsy, screaming on awakening, and immediately falling into stupor. Continually picked at face and body. Differential count showed leucocytes and polynuclear ratio both increased. At a consultation held by Drs. Berens, Dench, Roos, and Dougherty, an exploratory operation for the presence of cerebral abscess was decided upon. At 7 p. m. the patient was anesthetized by Dr. Gwathmey, and with the assistance of Dr. Roos and Dr. Berens, Dr. Dench being present, the tegmen tympani was removed, and the sphenotemporal lobe explored with negative results. Careful palpation of the exposed dural surface disclosed considerable tension, with a patulous point immediately below the knee of the sinus. Incision at this point evacuated about a dram of pus. Exploration with a grooved director showed the abscess cavity to extend backward and downward about an inch and a half. A cigarette drain was inserted and the advisability of counter drainage considered. This being of easy and rapid performance at any time, it was thought better to defer it. At Dr. Berens' suggestion, a flap was made from the external canal, and packed firmly against the exposed sphenotemporal lobe.

November 22nd to 27th. The temperature ranged from 99

to 100°; pulse 84 to 96. The patient was at times irritable and restless, occasionally picking at clothes and talking irrationally. General condition fairly good, blood count indicating slight infection. Wound was dressed and a new drain inserted daily.

November 28th. Temperature rose to 103°, and pulse 160, irregular in character. Speech became indistinct and incoherent, and patient suddenly collapsed, being cyanosed and pulseless. Normal saline solution was infused, and without removing her from her room a portion of the occipital bone was removed and an incision made in the lower part of the abscess cavity, through and through drainage being established by means of the insertion of a second cigarette drain to meet the distal end of the first. The temperature dropped to 100.8°, and pulse to 96, the latter being more regular and of better quality.

November 29th to December 9th. Pulse ranged from 96 to 108, fairly full and regular; temperature 99 to 100°. The drains were removed and reinserted every day, occasionally being shortened.

December 10th. The lower drain was removed, the central and lower portions of the cavity being practically closed.

December 14th. The upper drain was left out.

The patient since the counter drainage, was at times restless and irrational, but the sensorium was generally normal. Headache was occasionally present.

December 14th to 29th. The patient maintained a fair average condition, and was able to sit up in bed for short periods.

A large cerebral hernia which had developed through the upper incision and a smaller one at the lower, were treated during this time by compression, but without very material result.

December 29th. The patient was anesthetized and an attempt made to as far as possible close the wound and give support to the larger hernia. The external canal was denuded of epithelium, with the idea of forming a solid anterior supporting wall by forcing the complete closure of the canal. The auricle was dissected up and drawn backward, and the edges of the wound approximated as nearly as possible, being retained by strong sutures.

December 31st. During the night the patient became very restless and nauseated, occasionally picking at the bedclothes; pulse weak and intermittent, evidently suffering from cerebral compression. The pressure was relieved by cutting the retention stitches, with a complete subsidence of the symptoms.

January 2nd. Complained of slight pain in right ear, the temperature rising to 101°. Examination showed drum membrane inflamed and bulging, and myringotomy was promptly resorted to.

January 2nd to February 10th. Wound was treated as an ordinary open wound, slight pressure being maintained on the hernias, the smaller one having almost entirely disappeared. The exposed surface being so large, the question of covering it was considered, and Dr. J. A. Bodine was called upon for an opinion as to the advisability of a Koenig operation, but advised against it and suggested a flap from the scalp and periosteum above the wound. Accordingly, under general anesthesia, a triangular flap, including the periosteum, slightly larger than the exposed surface, was taken from the scalp, leaving the apex attached posteriorly. This was brought down and anchored by retaining sutures, attached to the posterior aspect of the auricle and the neck. A considerable portion of the remainder of the scalp was then dissected up and stretched down as far as possible over the newly made raw surface. The flap adhered readily and healed firmly, except over the antroinferior corner, where a small skin graft was laid. The patient was discharged from treatment March 10th.

Contrary to expectation, fibrous contraction and formation of cicatricial tissue failed to make a stout support, and to-day the covering of the exposed brain is rather thin. The patient, however, experiences no inconvenience, except perhaps in the appearance of the deformity.

Case II.—Chronic suppurative otitis media; thrombosis of lateral sinus; cerebellar abscess.

The patient, J. D., laborer, aged 50, was transferred to my service from the medical service July 27th, suffering from chronic otitis media; had been under treatment for chronic bronchitis.

Previous history. Had suffered for years from shortness of breath and palpitation of the heart. Had chronic cough.

Did not remember when ear began to run; had always been troubled by it at times. For past two weeks had had throbbing pain in right ear with profuse discharge, and for past week had had difficulty in closing right eye. Examination showed the external canal blocked by a mass of polyps, tenderness over tip and antrum, and slight facial paralysis. Examination of pus showed mixed infection, streptococcus and staphylococcus. He refused operation.

August 5th. At noon patient had severe chill, his temperature rising from 99.6 to 103.4°; had vertigo and nausea; pupils normal in reaction; no nystagmus, no optic neuritis. Leucocyte count 15,000; polynuclear 82%.

August 6th a radical mastoid operation was done; the bone was soft and infiltrated with pus; antrum filled with pus, and middle ear with granulation tissue and polyps; facial nerve exposed. The sinus was partly exposed by carefully curetting away the necrotic bony covering. The walls were angry grayish red in color; no pulsation present. The sinus was then laid bare from just above the bulb to midway between the knee and torcula, showing a healthy color except at first point. Compression being made over these ends by means of pledgets of gauze inserted under the bony edges, the sinus was opened, revealing the presence of an organized clot, which was removed. Curetting backward and downward, no further obstruction was encountered, and free circulation was established in both directions. The exposed ends were then closed by compression with tampons of iodoform gauze and the wound dressed.

August 6th to September 1st. Patient's general condition good, temperature ranging from normal to 99.8°; pulse full and regular, rate about 84.

September 1st to 7th. Patient not so well; drowsy and disinclined to sit up; irritable when aroused.

September 7th. Had chill and nausea in the evening; temperature rose suddenly to 103.6°; pulse 120—small, irregular. Somewhat irrational, and very drowsy. When raised in bed, complained of vertigo toward the left side. Nystagmus toward the affected side and neuroretinitis present. Leucocytes 32,000; polynuclears 87 per cent. Spinal fluid normal. Ordered immediate operation. The tegmen was removed and the sphenotemporal lobe was explored with a long, thin, straight bis-

toury, but with negative results. Inspection of the dura under knee of sinus revealed a small point apparently ready to rupture. Incision over this resulted in the evacuation of considerable pus. Probing with a director, the direction of the abscess cavity was found to be inward and backward. A large cigarette drain was inserted, and the wound dressed. The temperature dropped to 101°; pulse to 96.

September 8th to October 1st. Recovery uneventful. Drain removed every day for a week, and then every other day, using shorter drains frequently, until eventually, October 1st, it became impossible to reinsert it. During this time the temperature kept at about 100°; pulse rate 76 to 80.

A small hernia of cerebral tissue appeared around the drain at about the seventh day, and was removed with sharp scissors. Slight pressure was thereafter made around the drain with a wick of gauze. The wound granulated healthily, and was covered with a small flap from the scalp, aided by a few skin grafts. The patient left the hospital December 29th, and we have not been able to get in touch with him since.

An interesting point in both of these cases is the probability of direct infection into the cerebellum through contiguity of tissues.

XXXII.

ON THE POSSIBLE EFFECT UPON THE AUDITORY LABYRINTH OF THE EHRLICH-HATA REMEDY IN THE TREATMENT OF SYPHILIS.*

By Prof. G. Alexander, M. D.,

Vienna, Austria.

(Translated with the Author's Permission by George L. Richards, M. D., Fall River, Mass.)

Professor Finger recently reported three cases of syphilis in which there appeared peculiar and somewhat serious symptoms affecting the organs of hearing. It must, therefore, be our most diligent study to determine as early and as surely as possible, whether, in the presence of such symptoms, we have to do with poisonous action of the arsenobenzol upon the auditory nerve or not. I may be able to contribute some material which will aid in the clearing up of this question. For a period of six years I have constantly collected clinical and, as far as it was possible, anatomic material for the study of syphilitic diseases of the ear, and this material is for the most part already prepared for publication in the "Handbook of Genital Diseases."

Up to the year 1907 my material consisted of all those cases of syphilis which for purposes of diagnosis were sent from the two dermatologic clinics of the Vienna General Hospital to the Ear Clinic. Through the kindness of my colleagues of the Policlinic, privatdocent Dr. Nobl and privatdocent Dr. Brandweiner, I have had the opportunity to observe all the cases of syphilis appearing there since 1907. During the years 1907-1908 I also had the opportunity of examining the material from the clinic of Professor Finger. This gave me the opportunity to observe and diagnose those forms of disease of the ear, and especially of the auditory nerve, which give so few symptoms, and these so rapidly disappearing, that the patient

*A paper presented before the Gesellschaft fuer Aerzte, Vienna, December 6, 1910.

does not usually apply for treatment. For this reason such ear symptoms are easily overlooked. Finally, my material consists also of those cases in which the patient complained of trouble in the ear either at the time of or since the syphilitic infection that have applied for treatment at the ear department of the Policlinic since 1907.

A short time before the paper of Professor Finger was published he asked me the following important question, "Before we had the Ehrlich-Hata remedy '606' you had for a long time the opportunity to observe, and to methodically examine, my clinical material. Have you seen during this time any cases similar to those which I observed after the use of the injection?" This question I now answer. My observed material of syphilis of the ear, excluding those cases of diseases of the ear metaluetic in character (i. e., of tabes and paralysis), consist of sixty-eight cases. These have all been thoroughly examined and observed for quite a long time so that I am able to draw conclusions of both diagnostic and prognostic significance. In the course of the last six years I have seen twelve cases of ear disease appearing in the early stages of syphilis. Three of these cases showed disease of the external and middle ear, but in comparison with the cases reported by Professor Finger and Professor Urbantschitsch they show less severe affections of the auditory nerve and are, therefore, to be excluded. Comparing, now, my remaining nine cases with the three of Professor Finger, I obtain the following results: My nine cases represent a period of observation of six years; the three cases of Professor Finger of six months. In one of Professor Finger's cases the syphilis was of six weeks' duration; in the other two it was of three months' duration. Among my nine cases I can find only one in which the ear disturbance developed after thirteen weeks. In all the other cases in which the disturbance of hearing came during the early stage of the syphilis, it did not appear earlier than the fourth, fifth or sixth month.

We will now compare them as regards severity. Four of the cases showed a very slight degree of disturbance of the auditory nerve, slight dizziness or a slight degree of deafness, with subjective noises and a rapid favorable result. Serious or severe ear disease, as in Professor Finger's cases, I have observed in only five of my cases. One of them was treated

with atoxyl; in the other four the symptoms appeared after the ordinary forms of mercurial treatment by inunction or injection. From this it follows that acute syphilitic neuritis of the auditory nerve, whether localized in the cochlear or vestibular portion of the nerve, is, in the early stages of syphilis, very rare. During a period of six years, and with a much larger material, I have seen only one case more (5) with vestibular symptoms than has Professor Finger with his arsenobenzol-treated material during six months. In the literature up to the present time, cases of labyrinth syphilis, i. e., syphilitic inflammation of the auditory nerve in the early stages of syphilis, have been almost unknown. In his book on Ménière's symptom-complex, von Frankl-Hochwart surveys forty cases of syphilis. The symptom-complex of Ménière is nothing else than a disease of the labyrinth or the vestibular nerve, and the entire forty cases of von Frankl-Hochwart are those of chronic or latent syphilis. Professor v. Frankl-Hochwart has told me that he has never observed the Ménière symptom-complex in an early stage of syphilis. Politzer has reported the appearance of labyrinth syphilis in one case of syphilis of seven days' duration. This observation was made in 1878 and is, up to the present time, unique.

From the foregoing it is certain that the cases reported by Professor Finger, in so far as they are cases of disease of the auditory nerve in an early stage of syphilis, must be considered to have an etiologic relation to the arsenobenzol. It is not yet possible to assume with absolute certainty if during antisyphilitic treatment severe labyrinthine symptoms appear, that such symptoms are of necessity due to the treatment. Should one, however, defend this assumption, he must admit that it is possible to have, as Professor Riehl has rightly pointed out, severe cases of Ménière's symptoms, the severe acute forms of auditory nerve disturbance, even absolute deafness after or during the usual mercurial treatment. Among my material I recall two such cases, in both of which severe Ménière's symptom-complex appeared during the usual mercurial treatment. Both were, however, as are the other cases in the literature, cases of long-standing syphilis.

I now come to the consideration of my own observations on patients treated with arsenobenzol. These observations are based on the cases of syphilis treated by privatdocent Dr. Nobl,

with arsenobenzol, seventy-two in number. Regarding the other peculiarities of his observations he has already spoken. Of the seventy-two cases, there was only one in which, after the injection, symptoms of disease appeared in the organ of hearing.

The patient was a seamstress thirty years of age who acquired syphilis in the spring of 1910 and had injections of mercury. At the end of July disturbances of hearing appeared in the right ear. She complained of deafness and disagreeable tinnitus, increased by movements of the head. Dizziness was also produced by movements of the head and she had the feeling as though something was turning inside the head; she staggered toward the right side but did not observe any turning of herself or apparent rotation of the surroundings. She had neither nausea nor vomiting. There was at this time some disturbance of vision in the right eye. The patient came to my clinic early in August. Examination showed disease of the right auditory nerve in the cochlear as well as the vestibular portion. At this time the left ear was absolutely normal. Under treatment by Dr. von Zumbusch in the Rudolphspital the right-sided ear affection completely healed. She heard perfectly well in each ear and remained free of all symptoms until Oct. 2. On Oct. 16 she came to the clinic with the history that the right ear had remained completely healed but that on the afternoon of the 2d of October she suddenly noticed that she heard badly in the left ear and at the same time severe noises appeared. Examination at this time showed the right ear to be normal in every way while the hearing power of the left ear was greatly diminished (cochlear affection), but there were no vestibular symptoms to be attributed to the left side. The same day, Oct. 16, she received from Dr. Nobl an injection of the Ehrlich-Hata "606." After the injection the noises in the left ear stopped; she thought also that she heard better in the left side. Several days later sharp pains in the left ear came on, these extended down the neck and on to the back of the head and have continued up to the present time (Dec. 6) almost unchanged. On rising on November 10 she noticed that she heard very badly in the left ear, and the noises were as bad as in the beginning. On her way to the Polyclinic she had a severe attack of dizziness so that she very nearly fell to the ground; articles about her seemed to turn to the right and

she has had more or less dizziness since. On this date there was also some fever. Since Nov. 11 she has vomited two or three times daily. The dizziness is increased by changes of position, the attacks becoming paroxysmal on standing up or lying down, while during complete rest there is occasional freedom from the dizziness. Examination of the ear on Nov. 11 showed that the originally diseased right ear remained absolutely normal; on the other hand, the left ear had completely lost its function and the vestibular apparatus and the vestibular nerve did not react. This condition remains now, Dec. 6, unchanged. Since the middle of November there is also present a paralysis of the left facial nerve in all three branches. The paralysis is not complete, and the reaction to the faradic current still remains.

We have here a clinical picture under observation from the very beginning, as the patient before the Ehrlich-Hata injection had already, in the early stage of the syphilis, symptoms of disease in the inner ear of the right side. These symptoms affected the right ear only, and after treatment by mercury they entirely disappeared and complete healing took place.

Later, however, although still in the early stage of the syphilis, similar symptoms appeared in the left ear and became very much worse after the Ehrlich-Hata injection. Following this injection the disease extended itself over the entire area of the left auditory nerve and finally resulted in deafness and complete loss of function in the labyrinth of that side.

I think this case is suitable for bringing to our understanding the part which the arsenobenzol played as the etiologic factor in the production of the ear disease. It is important to notice that the arsenobenzol was given at the time when the left auditory nerve was acutely diseased. In my opinion the previously existing disease of the vestibular nerve presented a point of weakened resistance to the action of the arsenobenzol. The right auditory nerve, which was healed at the time, was not affected, but the left, already diseased ear was made much worse after the injection; hence we come to the conclusion that in cases of recent syphilis where there is already disease of the auditory nerve there is danger that the disease of the nerve will be made much worse by the use of the arsenobenzol.

Further observations will be necessary to determine whether

this danger exists only in the presence of already existing syphilitic disease of the auditory nerve, as in my case, or whether an already existing nonsyphilitic disease of the auditory nerve affords a predisposition or probability that the disease of the nerve will be made worse by the use of the arsenobenzol.

When one considers the experiments made with arsazetin, it seems probable that there is some danger of making the condition worse in every case in which at the time of the arsenobenzol injection there is already present disease of the auditory nerve, whether syphilitic or otherwise.

Ehrlich produced, by injecting white mice with arsazetin, phenomena similar to those of the true Japanese dancing mouse. Röthig has examined the central nervous system of the arsazetin-injected mouse after the plan of the work of Kreidel and myself on the ear of the Japanese dancing mouse. As an anatomic basis for the dancing movements of the arsazetin-injected mouse he found degeneration of the central fibers of the vestibular nerve. In order to answer the question why, apart from the optic nerve, the arsazetin finds its point of attack in the vestibular nerve in the white mouse, he examined the vestibular nerve in a larger number of normal white mice. He found that in the white mouse there was already beginning a certain amount of vestibular degeneration. The arsazetin finds, therefore, in the vestibular nerve of the ordinary white mouse, a point of lessened resistance. This explains, according to Röthig, why, after the arsazetin injection, there appears at once in the white mouse a severe degeneration in the vestibular nerve and at the same time a disturbance in the turning movements. From these conclusions we come to the following theory. It is not to be expected that a previously sound auditory nerve will be destroyed by the arsenobenzol injection. On the other hand, an unfavorable action from the arsenobenzol is to be feared whenever the auditory nerve is diseased previous to the use of the arsenobenzol.

Finally, I wish to state my own standpoint as an otologist with reference to the manner of the action of arsenobenzol upon syphilitic ear patients. More and more often is the question asked whether, in a case of syphilitic ear disease, the Ehrlich-Hata injection is indicated or not. After the preced-

ing observations, which naturally do not give an absolute finding, it is to be recommended to use caution in cases of acute syphilitic disease of the auditory nerve. Especially is caution in the use of the remedy to be recommended in the presence of acute or chronic disease of the auditory nerve in cases of recent syphilis, as here it is to be feared that the ear symptoms will be made worse. It appears to make no difference whether the disease of the auditory nerve is of itself of syphilitic origin or not.

An unfavorable influence is also to be feared in cases of acute syphilitic affection of the auditory nerve in old cases of syphilis or latent chronic syphilis. In cases of hereditary syphilis it is also to be recommended in the presence of acute manifestations of trouble with the auditory nerve to wait before giving the Ehrlich-Hata injection.

On the other hand, there are a large number of cases of ear disease in which the previously described dangers from the arsenobenzol injection cannot be considered as dependent upon it. Here belong the cases of chronic syphilitic affection of the auditory nerve with slight diminution of hearing power and considerable tinnitus, as well as the cases of chronic labyrinth dizziness. I would only mention that in these cases we had good results from treatment before the time when "606" achieved good results.

Finally, the Ehrlich-Hata has a good effect in cases of chronic labyrinth disease in chronic syphilis. The good results reported by Professor Urbantschitsch in one case of hereditary syphilis and in two cases of cochlear disease and chronic syphilis encourage us to proceed farther along the path already laid out.

NOTES BY THE TRANSLATOR.

The three cases of Professor Finger to which reference is made were those cases out of 170 treated with "606" which showed ear symptoms after the injection.

CASE I, male, twenty-two years, came to the clinic Aug. 20, 1910, with cutaneous syphilis and osteoperiostitis of the tibia. Aug. 24, 0.5 neutral Ehrlich-Hata injected. Aug. 25, nystagmus, dizziness, typical falling symptoms, but with intact hearing. Diagnosis by the Ear Clinic: Isolated disturbance in function of the vestibular nerve. Complete recovery in a few days.

CASE II, male, twenty-five years of age, syphilis six weeks. Aug. 27, 1910, 0.45 Ehrlich-Hata, method of Wechselmann, injected. Sept. 8, initial lesion healed, patient discharged. No sign of secondary syphilis up to Nov. 2, and Wassermann negative. On this date, nine weeks after the injection, and three months after the infection, dizziness and deafness appeared. At the Ear Clinic the diagnosis of bilateral labyrinthine deafness was made. The condition remains unchanged.

CASE III, female, eighteen years, came Aug. 1 for macular type of syphilis of three months' duration. Aug. 5, 0.45 neutral Ehrlich-Hata, method of Wechselmann, injected. Aug. 17, all signs of syphilis had disappeared and she was discharged cured. On Nov. 3 she was free from syphilis. Wassermann reaction negative. Nov. 3, complained of dizziness, headache, and the Ear Clinic made a diagnosis of labyrinthine deafness, dizziness and spontaneous nystagmus. There is no improvement at time of reporting, Nov. 27, 1910. (Wien. klin. Wochenschr., No. 47 and No. 51, 1910.)

At a subsequent meeting of the Gesellschaft für Aerzte in Vienna, before which Professor Finger's paper was read, some other cases in addition to those of Professor Alexander were reported where ear disease had appeared as late manifestations after the use of the Ehrlich-Hata.

v. Zumbusch had found in the literature, among 7,000 cases from twenty-five clinics, 9 cases of auditory nerve disturbance, all being cases with secondary manifestations from second to seventh month, and in most cases the Wassermann was negative.

Dr. H. Frey reported a patient injected on Aug. 9 with 0.5 arsenobenzol who returned late in October with deafness and some vestibular nystagmus. This case later showed the exanthemata of syphilis so that Dr. Frey was not certain that these manifestations could be laid to the arsenobenzol. (Wien. klin. Wochenschr., No. 50, 1910.)

Through the kindness of Dr. Daniel Kaufmann, I was given the opportunity of seeing two cases, each of whom had deafness and labyrinthine symptoms some time after the Ehrlich-Hata injection. At the time of the appearance of these symptoms the Wassermann reaction was positive. Both patients were given mercury by injection, and when I saw them all symptoms were improving. Here it might be difficult to say

whether the ear symptoms were due to the arsenobenzol or to the uncured syphilis. In Dr. Kaufmann's opinion they were due to the arsenobenzol.

Professor Rille, of Leipzig, has recently reported (Berl. klin. Wochenschr, Dec. 12, 1910) three cases of ear involvement which may be briefly referred to:

CASE I, female, twenty-one years old, with no previous ear symptoms, maculopapular syphilide with involvement of the tonsil, was given an injection of Ehrlich-Hata, July 7, 1910. Four weeks after the injection, 0.45 gr., there appeared dizziness, noises in ear and deafness located largely in the right ear, where both air and bone conduction were lost. Later there appeared a partial facial paralysis and symptoms of choked disk in the right eye. Up to Nov. 15 there had been some improvement, there is some bone conduction, but conversation speech is not heard. The left ear is normal.

CASE II, female, eighteen years old. Ehrlich-Hata injection, 0.45, on July 10. On Oct. 10 pain in head and dizziness appeared and on the following day right-sided facial paralysis, followed in three days by optic neuritis. Under treatment with mercurial ointment the facial paralysis and other symptoms disappeared. Nov. 17, discharged cured.

CASE III, male, thirty-three years old. Injection of 0.7 Ehrlich-Hata, July 7. In middle of October there suddenly appeared a high degree of double-sided labyrinthine deafness at which his previous occupation, that of blacksmith, may have predisposed.

XXXIII.

A PRELIMINARY REPORT OF SOME TWO YEARS' EXPERIENCE IN MODIFIED BLOOD-CLOT SURGERY OF THE MASTOID REGION, WITH PRESENTATION OF CASES.

By Hugh B. Blackwell, M. D.,

New York City.

The following report is based upon a study of some 33 cases operated upon by myself during the past two years. They occurred upon the services of Dr. Robert Lewis of the New York Eye and Ear Infirmary, and Dr. A. B. Duel of the Manhattan Eye, Ear and Throat Hospital.

The three essential factors which make for success in all modified blood-clot operations on the mastoid bone are:

1st. General condition of the patient.

2d. Operation and operative technic.

3rd. Postoperative care and dressing.

1st. General condition of patient: All conditions of low bodily vitality with which there may or may not be associated a blood dyscrasia following an acute, or occurring in the course of a chronic, constitutional disease, are poor subjects for an attempt at blood-clot healing. There are practically no local contraindications to the use of this method, save in the presence of the gravest intracranial complications of aural disease. The presence of a subperiosteal abscess, exposed sinus or dura in the wound, or even a perisinus or epidural abscess, are not in themselves deterrent factors. It is, in fact, among the latter class of cases that the best results in point of time of healing occurred, no doubt due to the great increase in the vascularity of the walls of the cavity which is existent under these conditions.

2nd Factor. Operation and operative technic. This consists in, first, the rapid performance of a thorough mastoidectomy; by this we not only conserve the energies of our patient, but

at the same time leave him with a reasonably clean cavity filled with sterile blood with which to begin the work of regeneration, a work that he would be in no condition to take up were his strength exhausted by a previous prolonged surgical procedure. In addition, for reasons to be subsequently stated, the posterior bony wall of the external auditory canal is markedly lowered, the region of the antrum is thoroughly curetted out and the intratympanic masses of granulation tissue lying anterior to the antrum are removed until the short process of the incus becomes freely visible. At the conclusion of the operation frequently a myringotomy is performed, and the external auditory canal is always packed with plain gauze dipped in normal saline solution. The mastoid cavity is cleansed and a strip of iodoform gauze one-half inch wide, folded once, is laid in the bottom of the wound almost to the antrum, being brought out at the inferior angle. The cavity is then allowed to fill with blood and the incision is united down to within half an inch of its inferior extremity.

3rd Factor. The postoperative care and dressing. At the conclusion of the operation the concha is completely filled with a little pyramid of wet saline gauze. Similar gauze, folded, is laid parallel and posterior to the united edges of the wound. This is added to until it attains the height of the mass of gauze in the concha. No gauze is laid directly over the united edges of the wound. Loose layers of wet gauze are then laid over all. When the bandage is applied, it will be found that the pressure over the posterior mass of gauze draws forward the scalp tissues which lie behind the line of incision, and that the pressure over the pyramidal shaped mass in the concha forces that structure, together with the canal, inward and backward, thus diminishing the size of the mastoid cavity, a feat which would be mechanically impossible were the posterior auditory canal not previously lowered. Owing to this sinking in of the auricle and anterior flap, we secure a continuous layer of soft parts down to the antrum, a most valuable asset in subsequent healing. In from twenty-four to thirty hours after the operation the wound is dressed and the posterior drain is removed. Usually from this time on only the lips of the lower one-half inch of the incision are kept open with wet gauze, none being introduced into the cavity itself, save for the purpose of keeping the incision open at this point. The

sutures are generally removed at the first dressing, the external auditory canal repacked and wet dressing reapplied. At each subsequent daily dressing the canal is packed fairly tight and wet saline gauze dressings are used throughout the healing process as long as there is any evidences of much discharge.

The question of the dressing and handling of these wounds when the discharge is profuse is of considerable importance. As long as the patient is comfortable, has little or no temperature, and the soft parts around the wound present no inflammatory reaction, it is not indicated to split up the wound and pack it, no matter what the amount and character of the discharge may be. Under these circumstances one should dress the mastoid twice a day if necessary; the discharge may be removed when profuse by gently stroking the tissues over the wound with the thumb, from above downward, care being exercised not to separate the line of incision, and using wet saline gauze at each dressing. The gauze is kept moist by the external application of rubber tissue. The packing of the external auditory canal prevents its collapse and at the same time forces that structure back into the wound. One must remember that these wounds are not sealed, but that each one has an opening into its cavity placed at its most dependent portion, and that this opening is kept open. The drainage, therefore, is good. The main object of the wet dressing is that moist gauze readily absorbs the discharge, however thick, and does not stick to the edges of the incision and cake up the secretion, as dry gauze so frequently does.

Whenever packing is placed in the wound, which is very seldom, it is of the lightest character, only sufficient to produce drainage. The wound is generally freely stimulated at all times with balsam of Peru, poured in, or tincture of iodine applied with applicator. Masses of granulation tissue are never disturbed, but are encouraged as much as possible. The wound is allowed to heal as rapidly as it will, either from above downward or below upward, from within out or from without in. The advantages of this method in shortened time of healing and a better cosmetic result are obvious. There is, however, another advantage not often referred to, but which is of considerable importance to the patient, namely, that the dressings are comparatively painless, there being no packing to remove from the wound.

Of the thirty-three cases reported nineteen were adults and fourteen children under ten years. The average time of healing of twenty-two of the cases out of the thirty-three was 21 days. To the best of my recollection, the remaining eleven cases about corresponded in point of time of healing to the others. The average time of healing of the ten adults was 17 days and of twelve of the children the average time was 25 days. No case was pronounced cured until all of the posterior dressing was removed and the wound was dry.

Thirteen of the thirty-three cases had well-marked perisinus and epidural abscesses present. In nine there was a subperiosteal abscess. In six of the cases, sinus and dura were exposed in the course of the operation. Two of the cases operated upon were for recurrent mastoiditis. Two developed erysipelas, one during the third week of convalescence and the other seven days after the operation. In both of these cases the wounds were doing well when the erysipelas developed some distance from the wound. Both were mild cases. In one of the cases operated upon there was a marked dyscrasic condition present at the time of operation, so marked, in fact, that the patient was kept in the hospital for two months subsequent to the operation, owing to his general weakness and debility. The wound is doing well, though not yet healed.

None of the cases, so far as known, has shown any evidence of recurrent mastoiditis.

In conclusion, I wish to express my indebtedness and appreciation to Dr. W. S. Bryant for numerous valuable suggestions concerning these patients. Dr. Bryant saw nearly all of the cases, and it is to a large extent due to his zeal and interest that the results were obtained.

XXXIV.

THE SELECTION OF CASES OF CHRONIC SUPPURATIVE OTITIS IN WHICH OSSICULECTOMY IS INDICATED.

By O. A. M. McKimmie, M. D.,

Washington.

During the past ten years the radical mastoid operation for chronic suppurative otitis has been popularized to such an extent that other measures for the relief of this condition have been cast aside and almost forgotten. Medical men, like others, like to be in style; and the result has been that many of us have taken up new operations and made cases fit operations rather than operations fit cases.

Careful study of my own radical mastoid operations and those of my colleagues with whom I am closely associated has impressed upon me the fact that many of the cases operated on show no extension of the diseased process beyond the middle ear. In other words, the aditus, antrum and mastoid cells are frequently healthy so far as macroscopic appearances are concerned.

As a result I have tried to formulate some definite rules for my own guidance in selecting cases for the radical operation and those in which some less extensive operative procedure would be applicable.

In discussing this matter I am taking for granted that we are only considering cases in which local and general medical treatment and mechanical measures have been faithfully tried and have failed.

The necessity for operation of any kind may be discussed under three heads—

1. The cure of an annoying and possibly dangerous condition.

2. The prevention of complications from the extension of the diseased process.

3. Preservation or restoration of hearing.

I believe that the majority of otologists will agree that a patient with a chronic purulent ear is rarely in normal health. Not only is he affected mentally by the consciousness of his trouble, but is also subject to the physical discomfort of the discharge. His digestion is affected by the flowing of pus into his nasopharynx, where it runs down and is swallowed, and he suffers from a continuous mild chronic toxemia from absorption locally.

The extension of infection to neighboring structures is always a possibility in these cases and, while not so common as in cases of acute middle ear suppuration, is of sufficient frequency to demand a cure. The surgical measures for the cure of chronic suppurative otitis comprise ossiculectomy, the simple mastoid operation, the radical mastoid operation, and the Heath operation or some of its modifications. It is my belief that we can so classify our cases that we can definitely determine which cases are best treated by some one of the first three. Of the Heath operation I can only say that I have not employed it, and believe that the cases which Mr. Heath considers suitable for operation by his method are curable by the simple mastoid operation.

Kopetzky in a very able critique of the Heath operation, read before the Southern Section of this Society in 1909, gave a very clear exposition of the fact that in the cases indicated by Mr. Heath his method gave no better results as to hearing or cure of the suppuration than does the simple mastoid operation.

The question of hearing is a very important one to consider in determining between the radical operation and ossiculectomy. I am firmly convinced that hearing is improved, or at least not made worse, by ossiculectomy; while the radical operation shows a large percentage in which hearing is markedly diminished after operation.

The simple mastoid operation does not involve disturbance of the anatomic relations of the middle ear, and hearing is likely to be improved rather than diminished, or at least left in the condition existing before operation.

In cases without symptoms of internal ear, sigmoid sinus or brain involvement, when careful observation leads to the conclusion that the ossicles are intact, the discharge being profuse and of long standing but without offensive odor, the simple

mastoid operation offers a reasonable hope of complete cure without lessening the existing hearing and the probability of improving it.

In cases in which the mucous membrane rather than the bone is involved, there exists simply the need for efficient drainage which the simple mastoid operation provides.

There remain for consideration ossiculectomy and the radical mastoid operation.

Before stating my conclusions as to indications for ossiculectomy, it might be well to state what I consider contraindications.

Contraindications are:

1. A contracted auditory canal which would render the performance of ossiculectomy difficult, dangerous or even impossible. The attempt to operate under these conditions might result in impaction of the stapes, perforation of the round or oval windows, or injury to the facial nerve.
2. The presence of cholesteatoma.
3. Recurrent or persistent labyrinthine symptoms.
4. Discharge of foul odor and of greater quantity than could be produced in the middle ear.
5. Demonstrable caries of the roof of the posterior portion of the attic.
6. Caries of the posterior superior portion of the tympanic ring.

A contracted canal renders a perfect view of the operative field well nigh impossible; and it is dangerous in the extreme to trust to the sense of touch when working in the neighborhood of so many important structures.

If the foot plate of the stapes is present it may be impacted, or the round or oval window or even the facial nerve may be injured in searching for the remains of the incus, so that unless the canal be of sufficient size to permit a fair view of the field, ossiculectomy should not be attempted.

Cholesteatoma is a very positive contraindication because it is impossible to know how far the cholesteatomatous mass extends from the existing perforation or how deeply its pressure may have caused disappearance of bone.

In any operative case presenting labyrinthine symptoms any procedure to be of value must give sufficient exposure to enable us to inspect the horizontal semicircular canal and labyrinth windows, and this ossiculectomy does not do.

Persistent foul smelling discharge of great quantity indicates extensive involvement of the accessory cavities of the ear and demands some operation which will fully expose them.

Dead bone in the posterior part of the attic is in such proximity to the external semicircular canal and facial nerve canal as to make its thorough removal extremely hazardous unless it be done under direct inspection.

In general terms these contraindications to ossiculectomy may be considered indications for the radical mastoid operation.

The indications for ossiculectomy are:

1. Caries of the ossicles.
2. Intractable discharge of not greater quantity than could be produced in the middle ear.
3. Perforation in Shrapnell's membrane with odorous discharge and marked deafness.
4. Recurring granulation polypi.
5. Adherent malleus with marked deafness.
6. Large kidney shaped loss of drum membrane with the remains of the ossicles blocking the attic.
7. Recurring middle ear vertigo caused by thickened discharge or granulation pressing on the round window.

Perhaps the commonest cause of chronic suppuration of the ear is caries of the malleus or incus or of both of these bones. Caries of the malleus handle is readily recognized, and if the perforation is in the upper portion of the vibrating membrane or in Shrapnell's membrane, disease of the neck and head of this ossicle is easily diagnosed.

When the perforation involves the superior posterior quadrant of the drum the long process of the incus can be seen and its condition determined with the probe. In some cases, however, the long process has disappeared and the body of the incus lies too high to be seen or its condition or even its presence to be determined with certainty by the use of the probe. In other cases the posterior part of the tympanic ring projects so far forward as to hide the incudostapedial joint.

In such cases if the tympanic ring is intact, I believe ossiculectomy is preferable to the radical operation.

Many cases present a perforation so small or so situated that efficient cleansing of the middle ear cannot be effected and

the condition of the ossicles cannot be determined with certainty, the discharge, however, indicating by its persistence and odor the probability of disease of some bony structure.

These cases are particularly dangerous inasmuch as the drainage may become blocked at any time and so give rise to acute mastoid disease or spread of the infection to sigmoid sinus, internal ear, meninges or brain.

A perforation in Shrapnell's membrane indicates disease of the neck or head of the malleus or of the body of the incus. Not infrequently the head has disappeared as a result of the suppurative process and one can look through the perforation and see the internal wall of the middle ear. The hearing is affected not only by the chronic inflammatory changes in the cavity but also by the fact that the opening is so high that the cavity can never fully discharge itself.

I have one specimen, removed from the right ear of a colleague, which shows the whole of the drum membrane, except for a defect just above the short process, a carious short process and handle to which the body of the incus is joined by bony union. In this case the head of the malleus having been destroyed and both processes of the incus having been separated by the carious process, the body of the incus dropped and became attached in the position described.

A granulation polypus presenting through a perforation is practically always indicative of carious bone and nature's effort to cure it. The site of the base of the granulation is a matter of importance. If it springs from the internal wall of the middle ear or projects through a perforation in Shrapnell's membrane and keeps recurring after removal, I consider the case one suitable for ossiculectomy.

On the other hand, if it comes through an opening in the upper posterior part of the drum, I consider the radical mastoid operation indicated. Adhesion of the malleus handle to the internal wall of the ear is not only destructive of hearing but in itself may prove a distinct menace to life itself by gradually blocking drainage from above and causing pocketing and retention of secretions and thus may lead to extension of the infective process.

The number of patients showing almost complete disappearance of the vibrating portion of the drum, with the carious shortened malleus handle presenting at the margin of a large

kidney shaped perforation, is large, especially in cases of long standing.

Such cases are apt to present an attic packed with granulations and the remains of the malleus head and sometimes part of the incus which not only keep up discharge but tend to block up the aditus and prevent healing of possibly superficial and otherwise curable caries in that neighborhood.

A relatively small number of cases present occasional attacks of vertigo coincident with diminished discharge due to thickness of the discharge itself or to its crusting over the perforation.

This brings about accumulation of the discharge in the middle ear and resultant increased labyrinthine pressure by way of the round or oval windows.

In presenting these remarks I do not wish to be understood as decrying the radical mastoid operation. I freely admit that some cases which are subjected to ossiculectomy eventually require the radical operation; many, however, are cured by the simpler operation in which the risks are far less. Careful consideration of the indications outlined will, I believe, enable us to select those cases in which ossiculectomy is indicated and those in which the radical operation is to be elected.

XXXV.

REPORT OF THREE CASES OF REMOVAL OF COINS FROM THE ESOPHAGUS OF INFANTS BY A SIMPLE PROCEDURE.

By Harry L. Myers, M. D.,

Norfolk.

In view of the very tender age of the patients, the similarity of the cases, the almost universal existence of the one necessary instrument and, most important of all, the ease of the procedure, I feel that it may not be uninteresting to report the extraction of a coin from the esophagus in the cases of three infants. In recommending a procedure based on the success of only three cases, I realize that my position is not a strong one, but the gravity of the condition, its common occurrence and the frequent lack of the proper instruments for esophagoscopy with the requisite skill for its successful employment, gives me courage to report a procedure which, on account of its simplicity, is within reach of every surgeon who may be called upon to meet this troublesome emergency.

Case I.—On July 12, 1906, A. W., a colored male about 18 months, was brought to me by its family physician with a history of regurgitation of food and difficulty in swallowing for several days. The patient was somewhat fretful but otherwise presented no serious symptoms. Feeling confident that the child had some foreign body in the esophagus, resort was had to the X-ray and a coin shaped body was located in the esophagus lying laterally and situated well down near the stomach. The patient was taken to the hospital and chloroform administered. With the child lying on its back and its head extended over the end of the table, I passed several different kinds of esophageal forceps and succeeded in touching the foreign body, but failed to grasp it after many trials. Fearing to continue too long this manipulation and failing to extract the coin, I decided to attempt to push it on to the

stomach, believing that nature would be more successful in delivering it in the downward direction than I had been from above. To this end I introduced an olive pointed flexible esophageal bougie. I could feel it touch the top rim of the coin, hold momentarily and then slip by it; but when I attempted to pull it back to the top again, I found that it required some effort to withdraw it. Realizing that the olive point was beyond the coin and that the resistance to the withdrawal of the instrument could only be due to its having engaged the lower edge of the coin, I pulled very steadily to prevent its losing its scant hold; at the same time stopping the anesthesia to allow the reflex to assist by contracting the tube. The gradual steady pull resulted in the extraction of a penny. There was no bloody mucus or other evidences of trauma and recovery was uneventful.

CASE II occurred in the practice of a colleague, who asked me to bring over any instruments I might have for extracting foreign bodies from the esophagus. The infant, a white male child, aged 10 months, presented the history of having had a penny in the throat for six days. Swallowing was difficult and most of its food regurgitated. The baby notwithstanding this showed no other serious symptoms. A skiagraph showed the coin situated about two inches below the larnyx, lying laterally in the esophagus. Ether was administered and with the baby on its back and head extended over the table, each of the three of us present took a turn at the removal of the coin with forceps and the flexible bougie I had used in case No. 1, but with no result. In casting about for some other means I noticed a conical urethral bougie with a long wire-like handle, and it occurred to me that it might be successful; so I asked and received permission to try it. Passing the forefinger of my left hand down over the epiglottis and pushing forward the larynx, I passed the bougie held in my right hand along the finger as a guide and had no difficulty in forcing the conical end by the cricoid into the esophagus. The instrument passed beyond the coin without difficulty and I could feel the lower edge of the coin click into place over the proximal end of the cone. A steady pull delivered the coin without difficulty and with only a slightly bloody tinged mucus. The recovery was uneventful.

CASE III occurred in the practice of Dr. E. A. Land, by whose permission I report it.

A. B., a colored infant, male, about 10 months old, swallowed a five cent piece three days before being brought in for treatment. Symptoms—regurgitation of food; great difficulty in swallowing. It was observed that there was also considerable rigidity of the right sternomastoid muscle. A skiagraph showed the coin located in the esophagus about the level of the cricoid cartilage and lying in the horizontal plane. Having heard of the success of the bougie in case No. 2, the surgeon sent to a colleague for an instrument of this kind and made an attempt to use it without anesthesia; but owing to the rigidity of the muscles, and, I think, also to the position of the coin just behind the larynx, he did not succeed in passing it beyond the coin, although he could touch it. The child was then subjected to chloroform anesthesia and placed on its back with the head extended over the end of the table and a smaller bougie was tried. This passed easily and engaged the coin without difficulty. Considerable traction was required to extract the coin in this case, but it was accomplished without injury as in the other cases.

Admitting that esophagoscopy and modern forceps coupled with the requisite skill in their use, would be the better method in most cases of extraction of foreign bodies from the esophagus, I believe in cases of the nature of these just reported, that no method offers better chances of success and certainly this means leaves nothing to be desired in its simplicity.

XXXVI.

OSTEOFIBROMA OCCUPYING THE TONSILLAR FOSSA (PROBABLY OF STYLOID PROCESS).*

By A. L. Kelsey, B. S., M. D.,

Los Angeles.

The report I have the honor of presenting to you is that of an osteofibroma of considerable size occupying an expanded tonsillar fossa. The report is made not because of any peculiar circumstance accompanying the case, but as a record of one more example of a rare occurrence in this region.

Tumors of all varieties occur rather frequently in the various parts of the upper respiratory tract, and the tonsil itself is often the seat of these growths. Fibromata originating in the connective tissue of the tonsil or in its capsule are seen rather frequently. Bony or cartilaginous formations are often found in the tonsil, but after a fairly good search of the literature of the tonsillar region, I have not found a single case of a distinctive osteofibroma mentioned. I have no doubt that there may be a record of the occurrence of this tumor in the tonsil itself, but it must be rare. The occurrence of the same tumor in the tonsillar fossa and not involving the tonsil itself must occur much less frequently, because of the anatomic and pathologic conditions existing in this space.

Since, in the case under discussion, neither the tonsil nor its capsule was involved in the growth, it is rather to be presumed that its origin was in the styloid process; as it contains the necessary elements and is sometimes found prolonged into the tonsillar sinus, where it would be subjected to irritation and inflammation transmitted from the tonsil itself.

As will be seen later there was a history of prolonged tonsillar trouble in this case and, taking all things into consideration, I am strongly inclined to believe this to be an osteo-

*Read before the Western Section of the American Laryngological, Otological and Rhinological Society at Los Angeles, December, 1910.

fibroma of the styloid process; although the presence of a normal styloid was not demonstrated at the time of operation or afterward, leaving the question more in doubt than it should have been.

The patient, Mrs. B., age 49, was seen first September 5, 1910, and the following history was elicited: She had been a goitre subject since the age of 12 and had never been strong and robust. Six years ago she was ill for a month with a swollen right tonsil which showed an ulcer, almost gangrenous in character at its center, which healed under treatment by her physician. The patient says that one year ago there was again severe trouble with this tonsil and an abscess broke. Since this she had attacks of pain at intervals of a week or so in the right side of the neck and head.

Eight months ago, according to her physician, there began an attack of soreness and pain in this tonsil which was treated twice a week up to July, 1910. About the middle of June he noticed for the first time some enlargement in the region of the upper end of the tonsillar fossa, and advised a consultation. The consultation was postponed by the patient until September 5th because there was not and never had been much suffering. About the middle of August the patient noticed some enlargement externally in the depression behind the jaw.

Examination.—Patient rather thin and frail, though active and feeling quite as usual for her. A moderate size goiter is present without eye symptoms. Externally the space behind the angle of the jaw on right side does not show as deep a depression as on the left and feels firmer. Pharynx, nasopharynx and mouth in good condition. Right tonsil covered almost completely by a thick plica triangularis and the portion seen is lower than usual. Above tonsillar fossa the palate is bulged out by a mass the size of a walnut. No active inflammation is indicated. On palpation the idea is conveyed that there is a hard immovable mass present which is slightly lobulated and is as large as a walnut with the hull on. The mucosa over the mass is movable, but the tonsil cannot be further exposed by traction on the anterior pillar.

Because of the history, which indicated an apparently rapid growth, and for other reasons, a tentative diagnosis of sarcoma of the tonsil was made and its removal was advised.

The patient did not appear again for some weeks, when Dr.

E. W. Flemming was called in consultation and agreed with the diagnosis.

At a subsequent visit, some days later, it seemed to me that the mass was an outgrowth from the upper pole of the tonsil and that the mass of the tonsil was not involved. The patient at this was pronounced by Dr. Frank Bullard a fit subject for etherization.

October 14th the operation was done, with Dr. Bullard giving ether and Dr. Flemming and Dr. Eddy, the attending physician, assisting.

An attempt was made to enucleate the mass as a tonsil is enucleated, but it was soon found that there was absolutely no plane of cleavage between the tumor and the fossa. At this time I should mention that it was found the tonsil was very small and resting on the lower pole of the tumor. A distinct capsule was soon found, incised and peeled from the mass as far as space would permit. The tumor proved to be larger than thought and was so firmly wedged into its bed as to be utterly immovable by traction on a stout volsellum. The enucleation was finally accomplished after much difficulty by means of the Yankauer blunt tonsil dissector, hugging well the external surface of the mass, and guided by the finger.

The tumor extended outward and backward, occupying fully the space between the spinal column and the jaw and rested on the sheath of the internal carotid artery which could be seen pulsating after its removal.

The tumor measured 4 cm. in all diameters except the anteroposterior, which was 3 cm., and found to contain much hard fibrous tissue with considerable bone, and was pronounced by Dr. S. P. Black to be an osteofibroma. The bone extended through the mass in the vertical plane, the larger amount being at the top while it was rather narrow at the bottom. The position of the bone would seem to favor the idea of the styloid process being involved.

Postoperative history.—The patient was in excellent condition when the operation was completed and remained so for two or three days, when circulatory disturbance arose, the pulse getting irregular and going as high as 160. The attack was controlled, but recurred several times later. The wound did well and the temperature ran 99 to 100° in the afternoon for a few days and then became normal. On the tenth day the

pulse again became rapid, and irregular, and the patient had very slight delirium and was dull.

At 10 p. m. of this day Dr. H. G. Brainerd was called and, as the temperature was normal and the lungs showed no signs of disease, it was thought that the condition was one depending on thyroidism.

The condition was somewhat better the next day but in the evening the temperature went to 101° and she was slightly delirious and extremely restless. A slight dullness of the base of the left lung was found. From this on the patient grew rapidly worse, the temperature going up to 107°, the pulse to 160. Death resulted on the third day of this attack and on the thirteenth day after operation, evidently from a fulminating type of pneumonia.

SOCIETY PROCEEDINGS.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON OTOLOGY.

Meeting of February 10, 1911.

Obituary—Charles John Kipp, M. D.

By Wells P. Eagleton, M. D.

Doctor Charles J. Kipp, whose death occurred on January 13th of this year, at the age of 72, was a man of whom American otologists can be especially proud.

Of the esteem and veneration in which he was held by the community and by the profession it is but necessary to recall that he was at different times the president of the Medical Society of New Jersey, and for many years the president of its Board of Trustees, president of the American Ophthalmological Society, of the American Otological Society, vice-president of the American Medical Association, and president of the Board of Managers of the New Jersey Sanitarium for Tubercular Diseases; the originator and first president of the Society for the Relief of Medical Men of New Jersey; the first president of the Newark Medical Library Association and of the Babies Hospital of Newark. He was the executive surgeon of the Newark Charitable Eye and Ear Infirmary, consulting surgeon of the Newark City Hospital, St. Michael's Hospital, St. Barnabas Hospital, the German Hospital, the Mountainside Hospital, and the Hospital at Sommerville.

To us as otologists his career was notable, not alone for the large amount of scientific work that he accomplished and his frequent contributions to medical literature, but especially by his having been the teacher and originator of otologic and ophthalmologic knowledge to the whole profession of the state of New Jersey.

New Jersey has no medical schools, but he supplied this want by the organization of the first eye and ear clinic held within the state, that at St. Michael's Hospital; and later by the establishment and development of the first hospital devoted exclusively to the treatment of diseases of the eye and ear, the Newark Charitable Eye and Ear Infirmary. In both of these, while under his guidance, any man anxious to work could find opportunity and incentive to grow scientifically, for by his unaided personal efforts and scientific skill he had built up first, a clinic, known all over the state, and later a hospital with a staff of twenty-five, which at the time of his death had treated over 152,000 patients, which mass of clinical material he placed at the disposal of all the profession.

It can be truly said of him that he was the father of otology and ophthalmology in New Jersey, and he gave his great knowledge unstintingly to the profession and especially to the younger men whom he from time to time added to his staff.

To my mind, it is for this furnishing of opportunity and willingness to assist scientifically for which the profession as a body is chiefly indebted to him.

His knowledge was at the command of all the profession and his presence was to them a constant stimulant and incentive to scientific work.

A Case of Otitis Media Purulenta Acuta, Mastoiditis, Perisinus Abscess, With Perforation of Premastoid Lamina Simulating Furuncle of the Canal.

Dr. Hugh B. Blackwell. The patient presented first came to the New York Eye and Ear Infirmary some four months ago with all of the symptoms of a well marked furuncle in the external auditory canal, the drum being intact and only somewhat congested, and the hearing good in the affected ear. The point of greatest swelling was located half an inch from the external meatus on the posterior wall and its incision was followed by a free escape of pus and blood. Forty-eight hours later the condition had so improved that what little doubt there had existed as to the exact nature of the trouble was dissipated. The furuncle in the canal continued to discharge for a period of about two months, during which time the patient was constantly under observation. Finally, one day he reported at the clinic with a well-marked postauricular swelling, and was admitted to the hospital, for operation, on

the service of Dr. Robert Lewis. On elevating the periosteum and retracting the auricle forward a vertical perforation was found to exist in the posterior bony canal wall at a point underneath the furuncle in the membranous canal. On removing the external mastoid cortex a well marked perisinus and epidural abscess was discovered around the line of the sinus. The antrum was apparently sealed off, there being no evidence of disease in that region. The operation was then completed and a blood clot dressing applied. At the end of eleven days all the dressing was removed and the patient was pronounced cured. A week later, however, there was some little seepage for a few days. With that exception the recovery was uneventful. Throughout the entire time during which the patient was under observation there was no perforation of the drum. In addition to showing a quick recovery in a modified blood clot operation, the case illustrates the extreme difficulty of diagnosing a mastoiditis where there has occurred a perforation in the premastoid lamina, simulating a furuncle.

DISCUSSION.

Dr. Perkins said that the case was a most interesting one, and these conditions are most difficult to diagnose. In Dr. Dench's service this fall there have been three such cases which were very puzzling. In one there had been a discharge for some time. There was a granulation in the posterior wall and when that was removed the discharge continued; the drum looked nearly normal. At no time was bare bone encountered. The first smear gave a negative result, but a later one showed streptococcus capsulatus, and the mastoid was opened and found completely disorganized. In another case the swelling in the posterior wall occurred after recovery from pneumonia; the swelling was marked and after incision there was quite a free discharge. On inserting a probe bare bone was encountered, and when the mastoid was opened a sequestrum was found almost filling it. In the third case the abscess was seen at the start and its nature suspected, and the patient was sent to the hospital. On incision two days later the probe encountered bare bone. It proved to be a streptococcus infection and the mastoid was opened and found extensively diseased. The case illustrates the importance of finding bare bone by the probe, and the bacteriologic examination. There have been

cases, however, where the bacteriologic examination has been deceiving and the mastoid opened without finding disease. One cannot be too careful in treating cases showing swelling in the posterior wall of the canal. In some of these cases the pus will have been found to have dissected its way out through the Rivonian segment and to have broken posteriorly. This has been supposed to occur only in children, but a case not included in those referred to had recently occurred in Dr. Dench's service in a boy of fourteen proves that it may also occur later in life.

Dr. Guntzer inquired whether there were any external symptoms of middle ear disease.

Dr. Perkins replied that the second case had a middle ear discharge; in the first, middle ear was intact, so that a furuncle was suspected, and only when the bacteriologic examination revealed streptococcus capsulatus was the condition recognized. In the third case the mastoid was opened in the presence of a large area of bare bone and the profuseness of discharge from the incision in posterior wall.

Dr. Hopkins said that they had been making some X-ray investigations in the laboratory recently to determine if disease could be diagnosed in such cases as these, and in two-thirds of the cases they had secured very satisfactory results. The X-ray showed that the bone was diseased; the mastoid on the diseased side presented an entirely different appearance to that on the healthy side. If radiographs were made in cases like these it might help in the diagnosis.

A Speculum for the Direct Examination and Treatment of the Eustachian Tube.*

By Sidney Yankauer, M. D.

DISCUSSION.

Dr. Wilson said that he had seen Dr. Yankauer demonstrate these instruments on some patients in Boston, and had introduced the speculum himself and looked at several of the patients, and thought that if a novice like himself could see the fossæ of Rosenmüller and examine the tubes so easily, the instrument would certainly prove to be a practical one, and most useful to the aurist.

*See page 421.

DR. MYLES said that all would hail with pleasure any instrument that would help in studying the fossæ of Rosenmüller. Some years ago he had read a paper on the fossæ of Rosenmüller and had presented photographs showing the anatomy. It is quite a frequent occurrence to see bands from the eustachian tube to the parts above; in many cases that he has examined after adenoid operations he has seen complete adhesions as the consequence of the operation; where much of the mucosa of the rhinopharynx and fossæ had been removed, the adhesions seemed greater. These can be broken best with the finger covered with a rubber cot, but they frequently recur. He hoped that Dr. Yankauer's instrument would permit the application of nitrate of silver to these points and thus aid in preventing the recurrence of the adhesions. The patients at first object to applications in this region, but after a little training become more submissive.

DR. BERENS said that from looking at the instrument and hearing Dr. Yankauer's description, he would judge that an important advance has been made not only in the treatment of the fossa of Rosenmüller but also in the treatment of the eustachian tube from the ear standpoint. His own experience had taught him that the fossa of Rosenmüller is a most important part of the anatomy, from the aurist's standpoint. He curettes them out carefully with his finger nail, and is then very careful about the after treatment. As Dr. Myles had said, the mass that has been removed is often followed by granulations, so that the patient may be worse after the treatment than if he had been let alone.

A Case of Mastoiditis Followed by Cerebral Symptoms, Relieved by Decompression Operation.*

BY CHARLES E. PERKINS, M. D.

DISCUSSION.

DR. DAVID E. HOAG said that the boy had been sent to him a little over a week ago by Dr. Perkins for examination to see if some light could be obtained upon the pre-existing condition from a neurologist's standpoint. He had seen him twice, and had looked him over very carefully, but found no conditions other than might be found in a normal child. Besides the ex-

*See page 432.

aminations, he had given considerable thought to the case, and Dr. Perkins' very prompt recognition of the gravity of the symptoms and his immediate decision to operate had certainly secured most brilliant results. Dr. Perkins had asked for possible light on the pathologic conditions which had led up to the symptoms and the necessity for operation. A prominent neurologist who is now dead used to say that in certain spinal cord and brain conditions there were many times a sort of pathology which might be called speculative pathology, and in this and many other cases we can only speculate as to what has occurred. The principal signs, as Dr. Perkins gave the history, were the convulsive seizures limited to one side, practically simulating an epileptic attack, and passing into a condition of unconsciousness, and a certain amount of optic neuritis. It has been suggested that the boy may have had a typical epileptic seizure which might account for what occurred. That does not seem at all likely, for, as a rule, epilepsy does not commence at this age,—either earlier or else at the pubescent period. Again, in epilepsy the patient would not lapse into a permanent and increasing unconsciousness, but would recover. An infectious condition of the ear would lead one to think of abscess first, and yet the only symptoms displayed were the convulsive seizures and the optic neuritis. About half of the cases of abscess have convulsive attacks, but it is not the rule. Optic neuritis is not usually found in cases of cerebral abscess that run a rapid course, nor where the abscess is small. Then tumor might be thought of, ordinary tumor of the brain; that is a slow growth, and the optic neuritis is more intense in such cases. Usually vomiting is a symptom, and persistent and long-continued headache, and usually the mentality is defective. None of these occurred, so tumor might be left out. The only thing left was a meningeal congestion,—possibly an infective localized meningitis. If it was an epileptic attack and was relieved by Dr. Perkins' decompression operation, it is another case in which it was wise to do the decompression operation. It would seem that in this case there was an infective localized meningitis, following middle ear infection.

It will be recalled that Dr. Perkins' operation led him into the vicinity of the temporosphenoidal lobe, the most likely location for abscess following infectious conditions of the middle

ear, but as no pus was found that would throw out abscess. The pathology of abscess and infectious meningitis is closely interwoven, and as to when one or the other occurs depends partly upon the intensity and rapidity of the inflammatory action and the nature of the microorganism and the virulence of its action.

DR. EAGLETON said that if the fact that the cerebrospinal fluid was tinged with blood, and was not due to a faulty technic, then this would be of assistance in making the diagnosis. He had seen two cases in the Newark Charitable Eye and Ear Infirmary where the presence of blood in the fluid had preceded the death of the patient by a few hours.

DR. PERKINS replied that on operation there was no evidence of anything wrong. There was a seepage for a few weeks but neither the brain nor the dura seemed abnormal.

DR. JOHNSON inquired what forms of meningitis might be expected in case of infections from the ear.

DR. BERENS inquired whether it might not be possible that these conditions were due to some autointoxication. It is not extremely rare to find cases, especially in children recovering from an extensive mastoid operation, which exhibit symptoms of toxemia referable to an intestinal condition, without there being any real meningitis or any abscess. The mere fact that Dr. Perkins did not find a large amount of cerebral fluid when he cut into the dura would suggest that he did not seem to be quite clear that there was any reason for the decompression. The result was undoubtedly perfect—the boy is well and healthy—but Dr. Perkins had not been quite clear in his statement as to why he did the operation. He himself had had a case in the Manhattan Eye, Ear and Throat Hospital four weeks ago where a very extensive mastoid operation on a child only eighteen months old was followed by similar conditions. They had all disappeared after a free movement of the bowels and the child was now attending the clinic for dressing of the mastoid wound.

DR. RICHARDS said that we occasionally see cases of complicated mastoiditis, in which the patient suddenly passes from a lucid condition to that of coma, possibly having had convulsions, or having shown the symptoms of intracranial pressure; an operation may be done which reveals no condition to account for this. There may have been aphasia, or an optic

neuritis, or other head symptoms which suggested opening the brain and the investigation of it as the proper course to be pursued. We do this and find nothing, yet the patient returns to consciousness and eventually recovers as an uncomplicated case. We cannot say what takes place in these cases, and it is as Dr. Hoag had said, more or less speculative pathology.

Dr. Perkins said he thanked the members for the mild criticism he had received. As a matter of fact, the convulsions started at half past eight, and at first he thought they might be due to some intestinal trouble and would pass away, but as time went on and the patient remained comatose and was passing into a moribund condition, he did not feel justified in withholding what benefit operation might give. He had hoped to find something which would account for the symptoms but did not. It might be that the boy did have some intestinal intoxication, but it was difficult to decide that question. There was quite a brain hernia for some time—the brain bulged well up. Some cases have been reported in German literature where the symptoms were attributed to edema of the brain, which was relieved by operation. The cases are not rare in which after an operation of this kind all the symptoms clear up.

Dr. Johnson said that what he had wished to learn was whether sufficient investigation of the spinal fluid had been made to determine whether there was any infection which might have come from the ear.

Dr. Perkins replied that a culture had been made of the spinal fluid, and the pathologist, Dr. Dixon, had reported three colonies of staphylococci, probably from contamination.

Report of Two Cases of Cerebellar Abscess With Thrombosis of the Lateral Sinus.*

By D. S. Dougherty, M. D.

DISCUSSION.

Dr. Berens said that the two cases presented were very interesting to him, the first one especially, because through Dr. Dougherty's courtesy he had seen a good deal of it. In both cases there was a tendency to perforation of the internal wall of the lateral sinus below the knee. The location had very

*See page 434.

little to do with it, but the fact that there was a tendency to perforation would indicate that the abscess in the brain was formed by contiguity, i. e., by direct infection internally. The point Dr. Dougherty had made about the counter drainage was most important. The case had evidently developed a side pocket of pus and the one cigarette drain was not sufficient to drain this; it was good surgery to make a counter drain through the occipital bone. That procedure probably saved the patient's life. The case was a very desperate one, and Dr. Dougherty had hardly done himself justice in his account of it.

Dr. Richards said that the method of handling the sinus illustrates in general a point in technic which it is well to follow. Dr. Dougherty had stated that in curetting the lower portion of the sinus he established a return flow, and that a few days later he took out the vein and found it infected. When a clot extends down to an inaccessible portion of the sinus, even though we can establish a return flow by curetting, it is best to take the vein out before we attempt this, for the reason that the infection as a rule travels further along the vessel walls than the clot extends, so that if we establish a return flow by curetting, in many cases we will have to take the vein out also at a later time, it being infected, and there will be the risk of sepsis from delay in taking it out.

Dr. Dougherty, referring to Dr. Beren's suggestion regarding infection from contiguity of tissue, said that he agreed with him thoroughly. The infection was at that direct point. Dr. Richards' criticism was absolutely correct, but he had stated that on account of the patient's condition—being in a state of absolute collapse—he thought it best to go no further. He had expected to resect the vein, but it seemed best to get the girl back to her room and not allow her to die on the table; had he resected the vein then there would have been no chance of saving her life. It just so happened that a faulty technic saved the patient's life, for if he had pursued the operation as he had intended she would certainly have died.

A Case of Mastoiditis With an Unusually Superficial Sinus.

Dr. Frank T. Hopkins. Some time since a patient with a chronic discharging ear came to the Eye and Ear Infirmary for treatment for furunculosis. She was there about two

weeks and the furuncles improved, but did not disappear. During this time there was more or less tenderness over the mastoid, indicating involvement of the mastoid but the tenderness was not marked. The infection was a mixed one, and as the patient did not seem to be as sick as is usually found in a mastoid condition, investigation of the mastoid was delayed. After ten days, however, examination showed a streptococcus infection, and it was decided to operate. The first blow of the chisel opened directly into the sinus groove. During the operation he noted that as the chisel was struck, the bone instead of yielding in the usual way gave a cracking sound, as though a piece had been split off; and upon raising the bone the chisel was found to be resting directly on the sinus. The sinus, however, was not injured. The sinus was very far forward, and the middle fossa was very low and rested directly upon the sinus. A probe passed between the sinus and the middle fossa went into the middle ear; a backward curve gave a little cavity which might be called an antrum, lying beneath the sinus. These cases of very far forward sinuses are frequently met with, but one of such a superficial character, where the part above the sinus is not more than 1/16 of an inch thick, is not often seen. In going over some specimens at the Eye and Ear Infirmary, he found only one case in a long series. He presented a specimen from the pathologic museum of the infirmary to illustrate the case reported.

As he had already stated, he has been doing a little X-ray work in mastoid conditions, and had found it of assistance in determining the character of the mastoid by the skiagraphs. In this case it was established definitely that the sinus was very far forward, but this point was not so interesting as its extremely superficial position.

DISCUSSION.

Dr. Dougherty told of a similar case which was seen in his hospital service. He removed the cortex at the classical point for entering the antrum, and with the removal of the first fragment of the cortex he wondered what he was into; he soon found that he was in the sinus, and in order to enter the antrum he had to go behind the sinus and under it, working inward and upward.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON OTOLOGY.

Meeting of March 10, 1911.

Stereoscopic Radiographs of the Mastoid, Showing the Third Dimension.

DR. ROBERT CUNNINGHAM MYLES said that Dr. Cole had taken these radiographs for him with a view of finding out the relative condition of the mastoid, and they came out so much better than he had expected that he desired to present them with Dr. Cole's assistance in explaining some of the difficulties of the process by which the results were reached, and discussing the future of this method of attaining a diagnosis.

The method is not yet fully developed, but by it three dimensions can be observed. In regard to the external part of the head, in relativity, it promises many things. It may be possible to photograph a blood clot in this way. In one of these specimens presented half of the head is shown, leaving the side of the head photographed as though seen from the inside to the outside. Some of the frontal sinuses taken also show the relation, but they have not yet proved out as it was hoped they would—showing the relation of the ethmoidal and sphenoidal cells anteroposteriorly.

DISCUSSION.

DR. COLE gave the credit for stereoscopic work to Dr. Caldwell, and stated that his work on frontal sinuses was classical; his own research work being more limited to soft tissues and abdominal cases. There is absolutely no doubt that lesions which are undiscernible in a single radiogram, may be seen in a stereoscopic pair of radiograms. Stereoscopic radiograms of the head are extremely difficult, because two plates of equal definition must be obtained, and it is hard enough to obtain one good plate without getting two in succession. The head must be held absolutely rigid while the plate and tube are moved.

The presentation of the reduced negatives, viewed with a

hand stereoscope, Dr. Cole considers the best method for the general practitioner to examine stereoscopic plates. Roentgenologists, or persons familiar with the original plates, may use prisms for viewing the plates with very satisfactory results. There is also as much discussion among radiologists about the correct distance to move the tube, as there has been in the past about the correct distances that the lenses may be moved for ordinary stereoscopic photography. This point, and some others, are still to be decided.

Personally, Dr. Cole would have preferred not to show these plates until the technic has been perfected, but stated that perhaps Dr. Myles was wise to call attention to the field in which enough has been accomplished to give an idea of the aid promised in the future. If any of the men cared to pursue this work further, either Dr. Caldwell or himself would be glad to help with the method of showing the third dimension. At the present time this is the only hope of showing brain tumors. In the past, when we have obtained variations of density in a single plate, it was impossible to state whether it was a thickening or thinning of the skull or some area of increased density in the brain itself; stereoscopically this can be determined. Plates may be studied stereoscopically or pseudoscopically, one showing the outside of the skull and the other the inside. In all these plates, while both sides of the skull are taken, the part of the skull which is at a distance from the plate fails to show the detail which is shown in the parts near the plate, which accounts for our seeing only one side of the skull.

Dr. Cole asked for the assistance and cooperation of the members of the section in developing this method. Dr. Lang of Cincinnati, has shown that radiography is very valuable in the diagnosis of mastoid lesions and the otologists of Cincinnati are very enthusiastic about it. While Dr. Lang has done some stereographic work and has advocated it, it has not as yet become a routine practice, but Dr. Cole believes that lateral sinuses, ethmoid and sphenoid cells and the lateral views of the frontal sinuses will prove one of the greatest fields for stereoscopic radiography.

Dr. Myles said that what he had meant to say was that only half of the skull appeared,—the inside on one plate and the outside on the other plate. He had no claims to

make in regard to the method, but was most anxious to see it developed, as it promised great aid in determining extreme pathologic conditions, blood clot, brain abscess, etc. It will require a great deal of study and hard work to perfect it, for it is still in an unsatisfactory stage, although the plates presented are very remarkable. Dr. Cole had explained the difficulty of holding the head absolutely still, etc. The plates must be taken from different angles with the head in exactly the same position.

A Case of Necrosis of the Internal Ear Which Existed but Was Not Evident at the Time of Radical Operation.

DR. JOHN MCCOY. The patient, E. W., was seen by an ear specialist on September 17, 1909, and gave the following history:

German, age 32, married. His right ear had been discharging pus for several years. About two weeks before seeing the doctor he had contracted a cold, and following this had pain in the right middle ear and mastoid. The doctor kept him under observation for five or six days, and finally decided to do a Schwartz-Stacke operation, which was performed on Sept. 23rd. I was asked to be present at the operation, and witnessed a very complete and well done radical operation. There was pus and granulation in the middle ear and antrum, and softened bone down toward the mastoid tip. There was absolutely no evidence of extension to the internal ear.

The patient was put to bed after the operation, and on the third day his temperature and pulse were normal. For four days he did very well, but seven days after the operation, on September 29th, his temperature rose to 103°, and on the 30th the doctor asked me to see him. His temperature was 104° that afternoon, he had some photophobia, and was slightly apathetic. The conditions suggested commencing meningitis. His blood had been tested, and there was no bacteremia. His eyegrounds were examined, and the fundus of both eyes showed some hyperemia, but no actual inflammation. The doctor was asked if any tests had been made of the internal ear, but he said that the patient had complained of no symptoms referable to the internal ear, so that he had not thought of the internal ear. The turning test was tried, and his left ear responded and gave an after-nystagmus of thirty seconds;

the right ear responded very slightly, giving an after-nystagmus of five seconds. There was no spontaneous nystagmus. The caloric test on the left side was normal. The right did not respond to either heat or cold. The tuning fork was lateralized to the left side. With the Barany apparatus in the left ear he could not hear the loudest noise. That very strongly suggested internal ear involvement. The internal ear was opened that afternoon by Dr. McCoy, and, to the surprise of all, the cochlea was found to be a mass of stinking pus. The cochlea was curetted out. The infection must have been carried through the vessels. The temperature continued high, the patient became increasingly apathetic, and finally comatose, and died in six days of purulent meningitis.

The case teaches that if we are going to operate on a chronically suppurating ear, even though the patient does not mention any symptoms of the internal ear, it is well to test for them. These symptoms frequently have to be elicited. When the patient was asked if he had had any dizziness, he replied that he had had several slight attacks, but had attributed it to his stomach. On one occasion he had remained dizzy all day. The cochlear involvement is difficult to get at. If a patient becomes suddenly deaf, it would lead to suspicion of the cochlea, but in many cases where the infection is in the cochlea it is difficult to determine from the hearing tests how badly it is involved.

DISCUSSION.

DR. LEDERMAN recalled a case of internal ear involvement, though not bearing directly on the case presented by Dr. McCoy. The patient was a woman who had been shot in the ear, and three years later showed symptoms of internal ear irritation—deafness, dizziness, falling to the affected side. In that case the cause was still present—a bullet which had lodged in the middle ear, causing facial paralysis. The patient gave a history of suppuration and deafness in the ear from the time of the injury. It was impossible to see the membrane on account of a fibroma which protruded almost to the opening of the external auditory canal. When this was removed, the bullet was seen in position. It was removed later by a radical mastoid operation. A sort of bony capsule had formed around it, and it had been in place for three years. After the removal of the bullet the patient gradually improved.

When she applied for treatment the only symptoms complained of were vertigo, deafness and suppuration. The labyrinthine symptoms were the result of pressure, due to the foreign body imbedded in the external wall of the internal ear, at the site of the horizontal semicircular canal and facial aqueduct. Seventy grains of lead were saved from the bullet, though it had to be removed in pieces.

DR. KENEFICK said that before every radical operation it should be determined whether or not the internal ear was free from trouble.

DR. JORDAN said he had little to add to what had been said by the previous speakers. The case spoke for itself. It was generally conceded nowadays that the labyrinth should be tested before every radical operation, and that an existing labyrinth suppuration should be attacked at the time of the mastoid operation. Dr. Jordan then related a case which he had seen only a few hours before in consultation. A boy twelve years old suddenly developed meningeal symptoms three days ago. He had been perfectly well the day before, and the attack came out of an apparently clear sky. A year before this boy had had a fracture of the skull. A decompression operation had been done, and the boy had recovered quickly and completely. Now the same surgeon was called in again to investigate the old fracture. He reopened the old wound, exposed the dura and incised it and found everything perfectly normal. This excluded the old fracture as a causative factor. Then the ears were investigated, and it was found that the boy had had a chronic otorrhea of the left ear of long standing, and on the following day Dr. Jordan was called in to see the case. He found the boy in a stupor, with the symptoms of fully developed meningitis. A spinal puncture was done, turbid liquor was withdrawn, and found full of pneumococci. That excluded the epidemic form of meningitis. The ear showed a total defect of the membrane, with no obvious indication of any mastoid involvement, but intense swelling of the mucous membrane and profuse discharge. The labyrinth was tested with hot and cold (even ice) water; there was absolutely no caloric reaction. Hopeless as the case was, it was decided to open up the mastoid quickly in order to inspect the labyrinth wall and to search for a possible subdural abscess, the evacuation of which might check further menin-

geal infection. The mastoid was completely sclerosed, the antrum containing edematous mucous membrane. The dura of the middle and posterior fossæ was exposed. There was no extradural abscess, nor was there any apparent portal of entry in the labyrinth. Under the conditions it was decided to go no further and the wound was closed and dressed.

This case was in all probability one of an occult labyrinthitis which had suddenly led to an infection of the meninges, and which also showed the importance of the labyrinth test.

NOTE (added a week later)—The boy died after forty hours and no autopsy could be obtained, but a few days after his death his father was told by an eye-witness of an accident which had happened to the boy the day before his illness. He had fallen from the tailboard of a cart and struck on his head. He had been unconscious for a little while, but had recovered quickly and then went home without saying anything about it. His accident may have been the connecting link between the old suppuration in the labyrinth and the sudden meningeal attack.

DR. MCCOY, in closing the discussion, said that he had nothing to add, excepting that he felt if the patient had had a coincident labyrinthine operation at the time of the radical his chances would have been much better, and he might have gotten well, for he went on for eight or nine days following the radical operation with a normal temperature, and then something broke through; whereas if the internal ear had been drained during those eight or nine days the probabilities are that he might have recovered.

DR. KENEFICK said that he had happened to be present at the time of Dr. McCoy's operation, and felt with him that if the labyrinth had been tested before operation the man's chances of recovery would have been greatly increased.

A Fatal Case of Hemorrhage Following a Peritonsillar Abscess—Bleeding From the Throat, Nose and Ear.

DR. LEWIS A. COFFIN. On the 15th of February, of this year, there was brought to my clinic, at the Manhattan Eye, Ear and Throat Hospital, from the Ear Department, a little girl 21 months of age, who had been brought to the hospital because on the day previous there had been two hemorrhages from the left ear, the first early in the day, and slight; the

second, at 3 p. m., not profuse, but greater than the first. On examination the external ear was seen to be blood stained, there was a marked swelling below the angle of the jaw on the left side, and on examining the throat one saw the typical picture of a large peritonsillar abscess. The usual incision was made. Instead of pus there flowed from the incision a quantity of blood, such as one sees upon opening a hematoma. When the cavity was empty the flow ceased. There was no acute bleeding. The child could not be taken into the hospital, and I asked one of my assistants, Dr. McMurdy, to see her at her home. This was on Wednesday. During Thursday and Friday there was no bleeding, and the mother and sister, both unusually intelligent, tell me that she was playful and that they considered her quite well.

Saturday morning at about 6:30 the child asked her mother to take her from the crib to her arms. The mother answered that she hadn't the time, but would get her a glass of milk. As she started to do this, she heard something which caused her to turn again to the crib, where she saw her baby bleeding from ear, nose and mouth. She died almost immediately. The sequence of events from the child's first taking sick is as follows: On Tuesday, February 8th, she was seized with convulsions. A doctor was called and child was relieved after a mustard bath. Two days later a swelling was noticed below angle of jaw and child was very restless. An ointment was prescribed for the swelling. The throat was not examined. Three days later, or on Sunday, the child suddenly choked, whereupon the mother turned it head down and washed its mouth with glycerine and lemon. There was much "slime and phlegm" gotten rid of, and the child seemed relieved and better than for some days. On Tuesday, the day before coming to the hospital, the hemorrhages occurred from the ear, and subsequent events were as noted above. The child had met with no accident and there was no specific history.

Conclusions.—Not attempting to explain the convulsion, I should say that this child had developed a peritonsillar abscess complicated by an acute suppuration in the middle ear. On the Sunday morning when the child had a choking spell the peritonsillar abscess probably spontaneously ruptured and emptied, either in whole or in part. The ear may have ruptured at the same time, but be that as it may, the necrotic pro-

cess went on until the wall of some artery gave way, probably the carotid, possibly anomalously placed. The previously filled pus cavity filled with blood, some of which found easy exit through the open drum membrane into the outer ear. At the time the child came to the hospital active bleeding was probably controlled by a clot formation, which held for two days after the opening of the hematomatous sack. I have been unable to make an exhaustive search of the literature. I do not recall having seen reported any case presenting the peculiar chain of symptoms which I have just recited. Cases have been reported in which death has been due to hemorrhage from the erosion of vessel walls during a peritonsillar suppuration. They all fall into the same class and point the same lesson, viz., early incision.

Flatau in reporting a case of sudden death from hemorrhage following a late incision of a peritonsillar abscess, points as a special danger the erosion of the arterial wall in cases too long treated by the expectant method. In the case just reported the very grave mistake was made of not even looking into the throat.

DISCUSSION.

Dr. Myles agreed with Dr. Coffin in regard to the pathology of the case, and thought that he had solved the manner in which it occurred. He himself had never had a case of fatal quinsy. The Index Medicus, he believes, refers to a number of these cases where the patients died from the effects of quinsy. He has had a few cases of peritonsillar injury coming from the removal of deep tonsillar adhesions, where the tonsil was adherent to the deeper tissues, and the blood vessels were ruptured, causing a hemorrhage which extended by extravasation from near the hyoid fossa to the eustachian tube, and it was two or three months before the bleeding entirely ceased. The tugging and traction on the tonsils seemed to tear some of the blood vessels beyond the field of operation.

Dr. McCoy said that some years ago Dr. Newcomb had reported thirty-five or forty fatal hemorrhages following quinsy, and that this was another case to be added to that series. While quinsy is generally regarded as a very slight malady, cases of this kind make one think of the possibilities

in connection with it. Dr. Coffin's case was certainly a most interesting one, and he had never heard of one like it.

Dr. Jordan said that he had never seen or heard of a case exactly like the one reported by Dr. Coffin, and told of a case of quinsy in which there was no profuse hemorrhage from the incision, but an oozing which lasted for several days. He had to remain with the patient for several nights, and the bleeding was finally checked by continuous pressure. Nothing else seemed to have any effect. He had not been able to explain the case, although afterward it was found that the coagulation point of the blood was extremely high. The patient was an elderly gentleman with hardened blood vessels. Sometimes in these highly congested areas the bleeding is profuse and continues for a long time.

Dr. Leshure recalled a case presented at the Vanderbilt clinic, of a young colored woman. At first they could not tell whether or not the carotids had been injured, but the bleeding was profuse enough to cause anxiety. The pulsing could be seen very distinctly. It was just behind and internal to the tonsil, and might readily have been mistaken for a tonsillar hemorrhage. He had heard of another case recently in another town which had died. The patient had a very large peritonsillar abscess, and died in a few minutes. Whether the vessel was misplaced, or the knife inserted too deep, he did not know.

Dr. Coffin, referring to what Dr. Jordan had said about the possibility of the hemorrhage being from the incision or from the knife having struck the artery, said that in this case there was no hemorrhage following the incision for sixty hours, and that he was sorry that the question of hemorrhage from incision had come into the discussion, as by having our attention on that point we were liable to lose the lesson taught by the case just reported, namely, there is great danger in delaying incision, as when the pus is pent up there is danger of erosion of some of the greater blood vessels.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON OTOLOGY.

Meeting of May 12th, 1911.

Paper: A Preliminary Report on Some Two Years' Experience in Modified Blood Clot Surgery of the Mastoid Region, With Presentation of Cases.*

By Hugh B. Blackwell, M. D.

DISCUSSION.

Dr. Chambers said that for a good many years he had been operating very similarly, although he has not called it modified blood clot. It is a very valuable way of getting quick results. In the first place, the skin and lobe of the ear are washed just before operating and painted with tincture of iodine. After being sure that the canal of the ear is clean, the regular incision is made, and, if necessary, a cross incision also. The antrum is sought out and, only if required, curetting along the iter to the ossicles is done. He has never, however, had the nerve to take out the whole of the posterior ridge; a portion of that, at least, is generally left. It has been many years since he has had any resultant facial paralysis, such as occasionally occurred in the early years of his practice. After the mastoid is cleaned out, if there is any subdural abscess or sinus thrombosis, that is taken care of. The packing is put in through the auditory canal, pushing the first end of gauze to the tympanic ring and middle ear floor, so that when it is pulled out it leaves the canal a straight line as in nature.

He closes up the posterior wound with a single subcutaneous stitch, regardless of much or little bleeding. In case there has been much necrosis of soft parts, he allows a second piece of gauze to escape from the lower end of the wound. This gauze is removed in from one to several days. There is none of the depression Dr. Blackwell speaks of in the old-fashioned wound. Of course there is some depression if the mastoid exenteration has been very large.

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*See page 450.

He recalled half a dozen cases, the last one being complicated with a subdural abscess in a three-months-old child. At the end of a week the dressing was changed. At the second dressing the mother wanted to nurse the child and took it out of the hospital, and it has not been seen since. It was all right. Seventeen days seemed a long time for an average, if the mastoid wound is thoroughly cleaned out at operation.

Dr. Lederman inquired whether Dr. Blackwell makes it a rule to take off the posterior wall in all cases, and, further, if there is considerable suppuration, whether he syringes out the cavity, or mops it dry.

Dr. Rae congratulated Dr. Blackwell on the excellent results of his cases. He thought, however, that the name was misleading. The term "blood-clot" should be restricted exclusively to those cases in which the operative cavity was allowed to fill with blood and in which the postauricular wound was completely sutured. Healing by "blood-clot" did not seem at all compatible with the insertion of a drain. In the method described by Dr. Blackwell it rather appeared that the time of healing was hastened by lowering the posterior wall, by almost completely suturing the wound and in this way reducing the size of the operative cavity to a minimum. These cases should be carefully observed to note the later occurrence of secondary infections.

Dr. Hays agreed with Dr. Rae about the name of the operation. A short time ago he himself had showed a number of cases which he had called "primary suture of the mastoid wound," without saying what was taking place underneath. Long before he started in with this series at the Infirmary he had seen many of the blood clot operations, many of them being failures, and, being interested in the subject, he read it up very thoroughly, and found many criticisms on the operation, and was led to believe that the failures were due to the excessive amount of antiseptics used to clean the cavity. If all of the infected tissue is removed and the cavity washed out with a 1-5000 bichlorid of mercury or absolute alcohol, there will be a wall of deadened tissue formed between the blood clot and the tissue beneath, acting like a foreign body. It would seem to be not the question of the blood clot that forms, for a blood clot would be a very good area for microorganisms to

form on, but it is really a fibrous cavity, which has been made as close as possible by filling it. The narrowing of the cavity is of a great deal of importance. He has seen cases which for a week or two had considerable pussy discharge, but this usually ceases in two or three weeks. It is a question whether it is better to sew up these wounds, or if it is not just as well to put in a light packing, and wait until the first dressing and then close the wound. He had seen three cases this winter of Bezold's abscess and perisinus abscess, where he left in a small packing until the first dressing, and then brought the wound together with adhesive plaster, and they healed very satisfactorily. Instead of the saline dressing he uses a glycerin dressing, which has a hygroscopic effect. The last case he operated upon there was a subperiosteal abscess. As the tissues are in a pathologic condition a primary closure of the wound will not hold. The tissues are considerably thicker and are inclined to slough, and it would seem to be better to leave the closure of the wound until the second or third day.

Dr. Bryant expressed his regret at not having arrived in time to hear Dr. Blackwell's paper. He said that he had seen many of the cases presented and that he wished to compliment Dr. Blackwell on the excellent results obtained. He quite agreed with Dr. Hays about the deleterious effect of using antiseptics in the wound. A cause of failure in getting primary union of the mastoid wound lies in the incomplete operation—leaving infected material behind. Another source of failure, is the meddlesome treatment which the wounds often receive. A very important factor for success is to have the wounds as aseptic as they can be made by the use of the most rigid surgical technic, for it is much more difficult to convert a septic wound into an aseptic one than it is to keep an aseptic one aseptic. The bacteria added to a septic wound during the operation appear to be more important than the few original bacteria remaining in the wound after a complete operation.

Dr. Hurd suggested that if in cases where there was some discharge after the operation Dr. Blackwell would use a Bier suction cup, he would not only get out more pus, but would also increase the vascular supply. It is simply a hard rubber bulb with strong suction, and if placed in the posterior opening would draw out all the pus.

Dr. Kerrison said that he had been much interested in this

kind of work and regretted that he had not heard Dr. Blackwell's paper. He could not himself report any series of such operations, but had had a certain number of cases of mastoiditis operated upon in which after the middle ear had recovered its normal condition the formation of granulations in the mastoid wound had been slow. He had, perhaps, a half dozen of such cases in which as a secondary operation he had sewed the wound up, and usually with primary healing. Dr. Kerrison agreed with Dr. Rae that such operations should not be called a "blood clot" operation, and probably never so when even the smallest drain was used.

Dr. Rae had asked what percentage came back for secondary operation. Even if such percentage is large, it should not militate against this method so long as in the majority of the cases a decided hastening of the final healing is secured. Dr. Reik, of Baltimore, who still calls his operation a "blood clot" operation, and still sews up the whole wound, claimed in a recent discussion of this method only about 75 per cent of perfect primary unions. So long as he accomplishes this result, the benefit to his patients in the aggregate is obvious.

Dr. Blackwell, replying to Dr. Lederman's question about the posterior wall, said that he took down the posterior wall in every case, almost to the antrum. The canal does not close if it is kept packed. If that is neglected at a single dressing it may partially collapse. It must be packed at every dressing. As for the washing out of the wound, when the discharge is profuse, he had never found it necessary.

Dr. Rae had criticised the name of the operation. It does not seem quite appropriate to call a wound of this sort an unpacked cavity reduced in size. Most of these cavities were very large at the conclusion of the operation. Eight of the cases were perisinus abscesses occurring in adults, and the wounds were really enormous. The only packing was a little strip at the extreme anterior portion of the wound, and it was then allowed to fill with blood. Of course the cavities were reduced in size, owing to the pulling in of the soft parts, but these cavities were certainly filled up by the clot of blood.

He had not observed any secondaries in the series he had performed.

Referring to Dr. Hays' remarks: The cases are not sealed up. All the sutures are taken out in twenty-four hours, and

the wound is kept open in the most dependent portion until all discharge ceases. There is no tension. Very slight tension would cause the wound to open. Of course, in the old blood clot method, where it is not kept sealed, it was different, but where it is not kept sealed the surgeon certainly knows what is going on.

Dr. Hurd's suggestion in regard to the use of Bier suction seemed an excellent one, and he intended to try it. Dr. Kerrison was correct in what he said about dyscrasias. Such conditions form a contraindication to the operation.

A Case of Chronic Attic Suppuration Cured by the Administration of an Autogenous Vaccine.

DR. GERHARD H. COCKS. The patient, a man 20 years of age, came to Dr. McKernon's clinic almost a year ago with the following history: During an attack of measles in childhood the right ear discharged for a couple of days. Since that time until two years ago his ear gave him no trouble. Two years ago he began to suffer from hardness of hearing, right side. He consulted a physician, who performed some operation through the canal, presumably the removal of a polyp. Since then he has suffered from a purulent discharge with a bad odor, but never profuse. He has also been subject to headaches, often limited to the right half of the head, and vertigo.

On examination, a small perforation was found in Shrapnell's membrane, just above the short process. A drop of pus could be wiped away from this perforation, especially if the patient performed autoinflation. As he was unwilling to consent to any operative procedure, he was treated for eight months in the clinic by the instillation of alcohol, bichlorid drops and catheterization, but with no improvement.

On February 18th, about three months ago, I obtained a culture of the pus coming through the perforation, and Dr. Callison found pneumococcus in pure culture. An autogenous vaccine was made and administered by Dr. Callison twice a week, as follows:

February	21	400 million
"	24	" "
"	28	" "
March	7	" "

March	10	500	million
"	14	500	"
"	17	700	"
"	21	800	"
"	24	600	"
"	28	800	"
April	4	800	"

On March 21st, after eight biweekly injections, the ear became dry and the perforation closed.

The injections were continued about two weeks after the cessation of the discharge to insure a permanent cure.

Our treatment has cured the purulent discharge, headaches and vertigo for a period of practically two months.

The case is shown because one would naturally have supposed, unless vaccine treatment had been given a trial, that conservative measures were contraindicated because of the location of the perforation (in Shrapnell's membrane), which is supposed to denote disease of the ossicles in chronic cases.

DISCUSSION.

Dr. Chambers inquired whether any of the members were using enzymol for pneumococcus pus. He has used it for many years and has found it very valuable. It has sometimes stopped discharges containing other microorganisms, but always the pneumococcal. This is the first case he has seen where O. M. P. with a small perforation in Shrapnell's membrane had come to rest so successfully.

Dr. Carter inquired whether it was purely a pneumococcus infection, or whether the pure culture of this organism mentioned by the doctor had been obtained by differentiation. The question as to whether there were also present streptococci and staphylococci would have considerable bearing upon the treatment by vaccines. Pure cultures of any germ are seldom found in suppurative conditions of long standing.

Dr. Hays said that he had used enzymol on two or three cases recently, but the discharge seemed to be aggravated instead of lessened, and as they were private cases he discontinued its use.

Dr. Cocks said that the culture obtained showed a pure pneumococcus infection, not a mixed infection.

Paper: Dental Lesions as Etiologic Factors in Otalgia and Tinnitus.

By M. I. Schamberg, D. D. S., M. D.

DISCUSSION.

Dr. Charles E. Atwood said that he had been much interested in the paper presented by Dr. Schamberg, and appreciated the honor of a request to discuss it from a neurologic point of view. It seemed at first that a definite explanation had been found for all otalgia and tinnitus. The essayist had certainly demonstrated the very great importance of a careful examination of the oral cavity in these conditions. A minor criticism might be made of the use of the term "reflex pain." The term usually employed by neurologists, viz., "referred pain," would seem to be better. The connections of the sensory nerves of the face, on careful dissection, are found to be very intimate. Referred pains, as regards the viscera of the body, have been studied very carefully by Head, who has made a chart of the intermedullary segmentation, based on the location of hypersensitive areas which have resulted from visceral irritation. Apparently the only explanation of referred pains, in the case of the viscera of the body, is that the impulses are carried by the sympathetic nerves from the irritated viscera to the spinal cord, and then reflected over the sensory roots outward from the segment of the cord at which the irritation is admitted to the areas of distribution of these sensory roots, rather than to the viscera from which the impulses come. In the case of the referred pains of the ear, may there not be some similar explanation? All are familiar with the necessity of examination of the teeth in cases of facial neuralgia, but extraction has often been carried to an excess. Since the use of the X-ray we have been able to be more definite in our work, and have been able to discover conditions to which the writer of the paper referred.

Reference had been made to a western writer who claimed that dementia præcox was frequently caused by impacted teeth. That question is debatable. It is now realized that for the development of such a disease as dementia præcox there must be a constitutional or mental make-up which goes with the disease; and if this does not exist, no sort of irritation, such

as neuralgia from impacted teeth, could produce the condition.

Is it not possible that in some of the dental conditions mentioned an infective neuritis takes place which might explain the continuation of the pain after the withdrawing of the tooth and the treatment of the cavity?

The doctor said that he does not see many cases of otalgia in the nervous department of the Vanderbilt Clinic. They probably go mostly to the otologists. A paper of the kind presented demonstrates the value of team work by the various specialists in studying the etiology of disease.

Dr. Bryant stated that he had seen a great many cases of ear pain. In a few of them he could find no irregularities of the throat, nose or ear to account for the pain. According to his recollection, in all these cases the source of pain had been located by dentists in the teeth, and had been relieved by proper treatment. He had discussed the matter of otalgia with Dr. J. Ramsey Hunt, who considers it due in some cases to disease of the geniculate ganglion; but Dr. Bryant is inclined to attribute cases of otalgia of obscure origin to dental defect.

Dr. Lederman said that the paper recalled to mind a case which he has had under observation for some time, in which he had not as yet been able to localize the cause of the trouble. There is a possibility that it may be of dental origin. The X-ray is a valuable aid in such cases, where no organic cause can be discovered. In all such cases it is most important to have an X-ray plate made.

Dr. Henry C. Ferris said that he wished to present his tribute of appreciation of the beautiful demonstration of radiography that had been made. He could not disagree with anything that the essayist had said, but would report a case of septic infection which was referred to the mastoid and operated upon. During his convalescence the patient came to his office, and upon examining his teeth he discovered that the lower left bicuspid was discolored with no carious cavity. Upon opening the tooth and liberating the putrefactive gases, the man gave a cry of pain, and put his hand to his ear; upon being asked if his head had been touched, he said no, but that he had a severe pain in his mastoid. The doctor said that he introduced a solution of formaldehyde into the tooth and sealed up the cavity hermetically, and told the patient to return if he had any further disturbance. He returned at five o'clock in the morn-

ing, saying he had had a very uncomfortable night, and that the pain was all in the ear. The tooth was opened, and on liberating the gas the pain in the mastoid ceased. This was reported to the otologist. The next week the patient complained of pain, on the other side of the head, of a similar nature, and examination with the X-ray showed two molars in a septic condition, which were opened and sterilized, and the referred pain in the right mastoid disappeared.

As correspondent of the New York State Dental Society, Dr. Ferris communicated with eighty neurologists and alienists for their opinion in reference to brain disturbances from impacted teeth, and the responses were very interesting, but inconclusive. One-third of the replies were in the affirmative, one-third negative and one-third on the fence; so that this investigation in the neurologic field demonstrated very little consideration or appreciation of dental lesions by the neurologists —at least not sufficient to form any definite conclusions upon which to base a diagnosis.

An important point upon which Dr. Schamberg had not touched was the prevention of the impacted wisdom teeth, which he states occurs so frequently. The preservation of the full set of deciduous teeth and the prevention of improper pressure of the muscle mask of the face would prevent the impaction of a large percentage of these wisdom teeth. The force exerted upon the erupting teeth by the whole muscle mask of the face produces a distal position of the whole arch to the skull as an entirety, and the result is that when the time comes for the eruption of the third molar there is no room between the distal side of the twelve-year molar and the ascending ramus of the mandible, and it becomes impacted.

Dr. Kerrison said that the paper was most instructive to otologists, as showing that a routine examination of the teeth should be made in all cases where pain is complained of that cannot otherwise be accounted for. Probably we often look for dental defects and throw out this cause of trouble because there is no gross defect which the aurist can detect. The essayist had shown very clearly that many serious dental lesions would be quite beyond diagnosis by the physician.

Dr. Schamberg said that he hoped that he had not given the impression that he ascribed to the mouth the etiology of all the pains about the ear. He had merely wished to emphasize

the fact that a large number of cases about the face suffer from these referred pains, and it is highly probable that in a large proportion of these cases we may find coincident lesions in the mouth and ear. He has seen a number of cases where patients have had pain in the ear which he believed to be due to mouth lesions, and afterward found that they were under the care of otologists who were treating definite troubles in the ear that were responsible for the pain.

ABSTRACTS FROM CURRENT LITERATURE.

I.—EAR.

Concerning the Permeability of the Tympanic Membrane.

STEINSCHNEIDER (*Monats. für Ohrenheilkunde und Laryngo-Rhinologie*, Vol. XLIV, 1910, p. 461) has made a series of experiments both on man and animals to determine whether medication applied to the external canal can have any influence on the middle ear. He found it impossible to get iodine to pass through the membrane in sufficient quantities to be found in the urine. Also on the cadaver he obtained negative results with iodine. The experimentation on animals, however, showed that while Berlin blue and acid fuchsin gave negative results, he was able to get a carmin solution to penetrate through the drum and stain the mucous membrane of the tympanic cavity. He says there is no doubt but that small quantities of carmin solution placed in the external auditory canal will penetrate the intact drum and reach the mucous membrane of the tympanic cavity. *Horn.*

The Determination of the Upper Hearing Limit Both for Air and Bone Conduction.

STRUYCKEN (*Beiträge zur Anatomie, Physiologie, Pathologie, etc.*, Vol. III, 1910, p. 406) has modified the monochord of Savart so that it becomes a useful instrument in the measuring of the upper tone limit. The instrument consists essentially of a steel wire, which is drawn tight over a properly constructed metal frame on which a scale is marked. An adjustable clamp slides around the framework and binds the wire so that various lengths of wire may be brought into vibration. The instrument is constructed with a handle so that it can be easily grasped with the left hand, and the end of it so made that it may be placed against the mastoid process or other bony prominence in order to determine the amount of bone conduction. The wire of the instrument should not be over 50 cm. long and tuned so that 40 cm. will give 6,280 vibrations per second; 25 cm. would then give 10,070 vibrations; 20 cm. would give about 12,500 vibrations; 15 cm. about

16,600 vibrations, and 10 cm. about 25,000. The wire is most accurately set in vibration by a small felt rod moistened with benzol or turpentine. *Horn.*

The Relation of Otitic Meningitis to Cholesteatoma of the Ear.

DANELON (*Monats. für Ohrenheilkunde und Laryngo-Rhinologie,* Vol. XLIV. 1910, p. 760) has studied during the year 1908-1909 36 cases of meningitis; 14 of these followed acute purulent otitis media, 10 followed chronic purulent otitis media, and 12 cholesteatoma. From this study he says that it is important to distinguish between suppurative leptomeningitis when due to an acute suppuration or to a chronic one or to one complicated with cholesteatoma. In acute otitis the leptomeningitis is almost always a direct result of the suppuration. In cholesteatoma the meningitis is almost always secondary, following other intracranial complications, such as sinus thrombosis, brain abscess, etc. The simple chronic suppurative process occupies a middle position. The practical application of this fact is that given a case of meningitis in which one has found cholesteatoma, it is important that during the operation the surgeon must seek for some complication, carefully examining the wall of the sinus, and to broadly lay bare the dura of both cerebral fossæ, provided that the possibility of infection passing through the labyrinth has been excluded by a previous careful test of the function of the labyrinth. *Horn.*

The Relation Between the Vestibular Apparatus and the Cerebellum.

BARANY, Vienna (*Monatschrift für Ohrenheilkunde,* Vol. XLIV, Heft 5). As late as 1907 Barany had no idea of the relation between the vestibular apparatus and the cerebellum. At that time he believed that the cerebellum was the center for equilibrium, and that the reflex phenomena, which arose from the vestibular apparatus, were fully explained through their well-known connection with the vestibular nerve. For example: By irritating the vestibular apparatus with cold water, a nystagmus of the eyes followed. The irritation starting in the semicircular canals, traveled through the vestibular ganglion in the internal auditory meatus to the vestibular nerve

centers in the medulla oblongata, where they lie in close connection to Deiter's area, situated at the junction of the medulla and cerebellum. From this center the impulses pass, by way of the posterior longitudinal bundles, to the oculomotor and abducens center, and in this way bring about the characteristic eye nystagmus. Other impulses are sent downward by way of Deiter's nucleus and the vestibular-spinal bundle to the anterior horns of spinal cord and bring about disturbances of equilibrium. In this way the cerebellum itself had no hand in the process. About this time the work of Marburg and Bing appeared, on the experimental destruction of the lateral cerebellar bundles (Kleinhirn-Seitenstrangbahnen) with the accompanying atactic phenomena.

In order to understand the significance of this it is necessary to recall the well known relation between eye nystagmus and falling. If in a normal individual a rotary nystagmus to the left is produced, the patient falls to the right. If the head is bent 90° to the left the patient falls forward. If 90° to the right the patient falls backward.

In its final analysis this phenomenon cannot be explained by the changed position of the semicircular canals, but by the sensibility of the muscles and joints of the neck and head, the so-called "proprioceptive sensibility of Sherrington's." This sensation must meet at some point in the brain, the irritation arising from the vestibular apparatus, and the change in the innervation of the body musculature be brought about by the change in the innervation of the musculature of the head.

About this time certain peculiar phenomena connected with cerebellar ataxia were recalled which previously had no explanation. Most diseases of the cerebellum are accompanied by nystagmus. The difference between this nystagmus and vestibular nystagmus lies in the fact that vestibular nystagmus is always accompanied by falling in a certain definite way, as explained above, while the nystagmus of cerebellar disease bears no such relation. In addition, the turning of the head, at given angles, has, in the latter case, also no effect on the direction of the fall. A case of tumor of the cerebellum was now referred to Barany, where the patient would always fall spontaneously backwards and to the right. Cold water irrigation of the right ear brought about typical vestibular nystag-

mus to the left. The left ear also reacted normally to nystagmus as well as falling. If the head was bent to the right the patient fell forward, but when the same experiment was tried on the right side there was no change in the direction of the fall. In this way he was able to diagnose a right-sided cerebellar tumor, which was later confirmed by the autopsy.

A second case from v. Eiselberg's Clinic was presented, where there was great doubt as to the situation of the tumor. Typical caloric nystagmus could be demonstrated on both sides, but no influence on the direction of the fall could be shown either right or left. On account of the preponderance of symptoms on the left, the diagnosis was so made. The operation showed a tumor instead on the right side.

Cajal demonstrates in the recent (1911) edition of his book that the roots of the vestibular nerve end in the cortex of the cerebellum and on the way to the cortex of the vermis send out a number of collateral branches to the cerebellar hemispheres. Bolk, in his book, maintains that the hemispheres of the cerebellum have something to do with the innervation of the extremities. Barany himself noted that an ataxia of the same side was a regular accompaniment of abscesses of the cerebellum and also tumors of the cerebellar pontine angle.

These points led Barany to combine Grafe's touching experiment with the nystagmus test in normal individuals. (This experiment consists in allowing the patient to touch the finger of the examiner with his outstretched hand while his eyes are closed. The hand is then withdrawn and the patient is again ordered to find the finger, with his eyes still closed.) It was found that when the nystagmus was to the left the patient invariably pointed to the right. The theoretic conclusion was obvious. If in diseases of the vermis spontaneous falling took place, so in diseases of the hemispheres spontaneous mistakes in pointing must also take place. Later Barany had an opportunity to prove these theoretic conclusions in many cases of tumors and abscesses of the cerebellum which were referred to him for diagnosis. He concludes therefore that we are on the verge of very important discoveries in the diagnosis of tumors of the cerebellum, and a study of the original paper, which is very rich in details, would repay anyone interested in this subject. *Horn.*

II.—NOSE.

Oral or Nasal Route for Operating on the Septum.

HALLE (*Monat. für Ohrenheilkunde und Laryngo-Rhinologie,* Vol. XLIV, 1910, p. 826) in this article considers the question as to the relative value of the oral and nasal method of operating on the septum of the nose. He describes the three methods of operating on the septum through the mouth, in all of which the upper lip is carefully raised with the periosteum from the bony surface and turned up over the face. In the first method after elevating the lip, the periosteum and the mucous membrane are loosened from the lateral nasal wall and the floor and finally from the septum. If the septum is first attacked the mucous membrane over the cartilage is very easily torn. After the cartilage and bone are sufficiently bared the deformed portion is removed. In the second method the mucous membrane of the nose is cut and torn through at the pyriform aperture, the lip well elevated over the tip of the nose and the elevation of the mucous membrane of the nose and removal of the cartilaginous septum as in the former method.

LÖWE (Ibid., p. 1105) says that the incision through the lip should not be horizontal, but longitudinal. After proper cocainization, the lip is drawn upwards over the tip of the nose and the cut made directly in the median line from almost the edge of the lip downward through mucosa and muscle. The edges of the wound are held apart with automatic retractors similar to those used in the mastoid operation. The elevation of the mucous membrane of the nose should always start with that covering the floor and side of the nose, and later that of the septum. The submucous resection of the septum can then be carried out either according to Killian's or Freer's method.

Horn.

Indications for the Radical Operative Procedure in the Diseases of the Nose.

LÖWE (*Monat. für Ohrenheilkunde und Laryngo-Rhinologie,* Vol. XLIV, 1910, p. 1101) gives as indications for the radical operation on the nose the following conditions:

1. Tumors, either malignant or of such a character that by rapid growth they press on the neighboring structures, or, when not entirely removed, tend to recur.

2. All diseases of the accessory sinuses which have involved either the orbit, the cerebral fossa or the pterygomaxillary fossa. However, in certain cases where the indications of involvement are not very severe, the lesser operative procedures will be sufficient; but if, after the endonasal operations there is a return of the symptoms, the more radical procedure is indicated.

3. All chronic empyemas of the accessory sinus which are accompanied with multiple polyps, whose places of attachment are within the sinus cavities. The radical operation is indicated in these cases because it is probable that the interior of the cavity contains numerous other polyps which can only be removed when the cavity is completely opened up.

4. All empyemas of the ethmoidal cells in which the sagittal X-ray picture shows pus in the cells lying in the supra- and infraorbital plates, in which place it is not possible to reach the pus by the endonasal route.

5. In those cases of chronic empyema of the frontal sinus in which the X-ray picture shows that the endonasal operation has not succeeded in removing the pus from some of the extensions of the sinus.

6. All simple or complicated empyemas of the accessory sinuses in which the endonasal treatment has failed to bring about a cure, and in which there develops severe symptoms, such as high fever, severe pain, etc.

7. All cases of suppurative otitis, osteomyelitis and periostitis of the upper jaw which cannot be reached from the nasal openings.

8. All severe and extensive traumatic and ulcerative destructions of the interior of the nose.

9. All foreign bodies which cannot be removed through the normal passages, or which may be productive of harm should they be left in place. *Horn.*

Concerning Septum Operations in Children.

RÈTHI (*Wiener medicinische Wochenschrift*, November 19, 1910). Every malformation of the nasal septum does not necessitate an operation. Only such deformities, particularly those well anterior, causing difficulty in breathing, speech defects, nervous disturbances or interference with the proper

treatment of diseases of the accessory sinuses, should be operated on. In other cases the nose should be left alone.

Physicians are frequently misled in regard to the importance of deviations of the septum, particularly when a hypertrophic rhinitis exists at the same time. In such cases the septum operation will not be a success, because the hypertrophic condition and not the deviation was causing the obstruction.

The submucous resection operation, particularly in young people, frequently leaves a septum that moves about during respiration and causes the patient more distress than the original deformity.

In three cases the author has had to produce a perforation through this part of the septum. Contrary to the opinion of some writers, the author does not believe that a large septal perforation does any harm, in fact, in cases such as before mentioned, in which the submucous removal of a considerable part of the septum left a freely movable septum, the artificially produced hole through the septum is much to be preferred to the other condition.

The author believes that operations on the nasal septum in children should only be undertaken after the greatest deliberation and performed with great care. The author has seen seven cases in which the operation for deviated septum was performed in children between the seventh and twelfth years. The operations had been correctly performed by competent men. In three of the cases the child's breathing was not particularly relieved after the operation, especially at night, first one side and then the other being stopped up, and a history of these three cases discloses the fact that the nose in neither of the cases was particularly stopped up before the operation; that is, the obstruction was not constant.

The conclusion must be drawn that in these cases, too, the difficult breathing had been caused rather by a swelling of the mucous membrane than by the deviation. Some time after the operation, in all seven cases, there was a slight sinking in of the nose, in two cases quite marked. In one of the cases, after several months, the deformity slightly increased. This did not happen in any of the others.

The author years ago recommended a method for the correction of deviations of the septum which consisted in making a crucial incision through the septum. The author has oper-

ated on many cases of deviated septum in children by this method, and has never seen a sinking in of the nose afterwards.

In conclusion the author states that in children it is important, if radical operations have to be performed on the nasal septum, to put them off as long as possible, and when the operation is performed, to preserve so far as possible the bony portion of the septum.

If the submucous operation has to be performed, it will be well for the operator to get on if possible by removing very little of the septum. *Theisen.*

III.—PHARYNX.

The Tonsillectomy Question.

RÈTHI (*Wiener med. Wochenschr.*, No. 28, 1910) admits that there are cases where a tonsillectomy is indicated, where after repeated partial removals or slitting the tonsil the patient is not benefited, or where acute rheumatism or acute sepsis can be traced to the tonsil. The operation must only be done where very strong indications are present. Although the author has never seen an unfavorable result where a partial removal was done, in two cases where the complete operation was carried out a complete destruction of the singing voice occurred. He explains these unfortunate results as the result of disturbing scars. *Horn.*

Contributions to the Study of Ludwig's Angina.

DELIE (*Revue Hebdom. de Laryngol.*, No. 29, 1910) in speaking of the treatment states that it can only be surgical. It is best to open the abscess from the floor of the mouth when possible. If it cannot be opened in this way it must be reached from without, either by a lateral or median incision above the hyoid bone. The median incision is best, because no important structure can be wounded. The hypoglossal nerve may be injured, but this does not do any special harm.

The author gives the following characteristic points:

1. Rapid swelling of the sublingual fold.
2. Board-like swelling of the floor of the mouth, no fluctuation being apparent.
3. Absence of discoloration of the skin of the neck in the early stages.
4. General septic condition.

The author reports two cases in both of which the abscess was reached by the external incision. *Theisen.*

IV.—LARYNX.

Fatal Case of Superior Bronchoscopy.

CHIARI (*Monats. f. Ohrenheilk. und Laryn.-Rhino.*, Vol. XLIV, 1910, p. 877) reports a case of a boy, seven years old, in which upper bronchoscopy was done, with fatal results.

The child had inspired a kernel of corn, which, according to the X-ray, had located at about the left main bronchus. A portion of the kernel had been removed, when the child suddenly became cyanotic, and respiration and pulse ceased. At the postmortem the chief bronchus on the left side was blocked by a corn kernel, and the smaller bronchi filled with pus.

The author believed that the fatal result was due to the impaction of the kernel in the left bronchus, although it is possible that the case is a chloroform death, as that drug was used for the anesthesia. *Horn.*

The Use of Trichloracetic Acid in the Treatment of Tuberculosis of the Larynx.

SYTSCHOW (*Zeitschrift f. Laryngologie, etc.*, Band 3, p. 487). In a series of 25 cases the author has had some very favorable cases and considers this substance as far superior to lactic acid or any other of the caustic agents generally employed. He applies the pure crystal, without fusing it on the sound, and allows it to act as deeply as it will. If necessary a second crystal can be applied at the same sitting. He noted a complete disappearance of the dysphagia in 15 cases directly after the first application, and only one case in the remaining series needed as many as six applications. Ulcerations, some of them very extensive, began to clear up after the second and third cauterization. The cough and aphonia was much improved in several cases. He also had occasion to use the acid in various tuberculous processes in the mouth with most satisfactory results. *Horn.*

Bronchoscopy for Foreign Bodies, With Remarks Concerning Bronchial Asthma.

SCHRÖTTER (*Wiener medicinische Wochenschrift*, Nos. 3 and 4, 1911) reports the interesting case of the aspiration of

a tooth plate containing one tooth and with the following dimensions, 13 mm. long, 11 mm. wide; height of the tooth, 10.4 mm.; greatest width, 7.4 mm.

The extraction of the foreign body, which was accomplished under cocain anesthesia, with the patient in the sitting position, was unusually difficult.

The tooth was in the left bronchus, and with a bronchoscope 30 cm. long it was possible to get only within ½ cm. of the foreign body.

The operation, lasting about 18 minutes, was not followed by any reaction. The left-sided bronchopneumonia promptly cleared up, so that the patient could leave the hospital within a few days.

The writer emphasizes the point that an X-ray plate does not always show whether the foreign body is in the right or left lung.

It is important to get the radiograph during inspiration and a forced cessation of respiration.

Another point brought out in the writer's paper is the negative findings with percussion and auscultation. This is caused by the well marked bronchitis, usually bilateral, caused by the presence of the foreign body. The dyspnea is not entirely caused by a shutting off of a portion of the lung, but is also the result of the changes in the bronchial tubes. The author believes that an aspirated foreign body causes reflexly by irritation of vagus branches, an increased innervation and tone of the bronchial musculature accompanied by symptoms of a capillary bronchitis. This irritation of the bronchial musculature after aspiration of a foreign body may persist for a long time and may cause a sensitiveness of the mucosa of both lungs, a spastic condition persisting for months. The writer has before mentioned the good results following bronchoscopy in cases of bronchial asthma by the use of cocain or cocain adrenalin. Nowotmy and Galebsky have made similar observations. Ephraim's observations of the treatment of bronchial asthma by local applications of cocain or similarly acting substances are also quoted.

His results show that by this method of treatment attacks of bronchial asthma are not only directly benefited, but may remain away for a long period of time. *Theisen.*

V.—MISCELLANEOUS.

Discussion on the Latent Infections by the Diphtheria Bacillus and Administrative Measures Required for Dealing With Contacts.

R. M. BUCHANAN (*British Journal of Laryngology*, February, 1910). Latent infection may be regarded from a bacteriologic standpoint as the presence of an infective agent unaccompanied by any obvious pathologic change.

The identification of diphtheria bacilli in routine diagnostic work may be stated to depend upon the morphologic character of the organism. The great variety of forms presented by the diphtheria bacillus in cultures from the throat has led to repeated attempts to arrange these forms in definite classes or types. Cylindrical or cuneate forms are the two chief types; others are frequently seen in the same culture.

Culture tests are necessary to confirm the morphologic tests. The virulence of the diphtheria bacillus in apparently healthy subjects, whether designated contacts or carriers, is only slightly less than the virulence of the organism in patients. Observers are agreed that the bacilli disappear in the great majority of cases well within the usual six weeks of isolation. The spread of infection by patients who have recovered and been discharged from the hospital appears to be very limited, only .8% occurring in Glasgow. The infective power of a positive contact or carrier appears to be very limited. In a disease of such a short period of incubation and rapid clinical course the development of prophylactic measures is always a matter of importance. The segregation of all infected contacts and other carriers of infection has aroused the keenest interest and even controversy.

Any hard and fast procedure is not warranted from our present knowledge of the subject bacteriologically nor from our clinical experience. *Harris.*

A Discussion Concerning the Results of the Ehrlich-Hata Treatment in Vienna.

ESCHERICH (*Wiener medicinische Wochenschrift*, November 12, 1910). The important question as to the value of so active a remedy as Ehrlich's arsenobenzol must be first decided in various clinics, particularly in adult cases.

So little is known concerning the tolerance of young infants for this remedy that the greatest care must be exercised.

Ehrlich himself stated that the sudden destruction of the spirochetæ might result in a toxic condition. He recommended that as a beginning dose 0.005 g. pro kilogram of body weight should be used.

The author in his experiments started with this amount, and after satisfying himself that the injections did not do any harm, increased the dose to 0.01 pro kilogram, which is the largest amount that has been used.

Intragluteal injections are always used, and as a rule there is very little reaction. When first used the remedy was dissolved in methyl alcohol, but lately it has been placed in olive oil and the best results obtained.

The author's experiments were confined to nursing infants, and the cases were watched for a long time.

Six children were treated, and the following table will briefly show the results.

It is only fair to state that in the three fatal cases the syphilitic condition was so far advanced that they were considered hopeless from the beginning:

1. Infant artificially fed. Three weeks old. Premature birth. Papules on the face and extremities, saddle nose, with foul discharge; paralysis of both arms. Swelling of liver and spleen. Spirochetæ +. Wassermann +. First injection July 13, 0.04 g., followed by disappearance of paralysis and of the spirochetæ and increase in weight. On October 8, Spirochetæ —, Wassermann +. On this date there was a return of the symptoms, followed by death. Autopsy showed destruction of bony framework of nose, gummata of the liver and interstitial hepatitis.

2. Infant six weeks old. Artificially fed. Born with pemphigus. Extensive syphilides on the hands and feet. Sunken nose with purulent discharge. Spirochetæ +. Injection August 27, 0.01, followed by immediate improvement of all symptoms. Child died on September 5. Autopsy—Extensive atrophy of the organs. Perifolliculitis and pigmentation of the mucous membrane of the large intestine.

3. Breast fed child, aged six weeks. Papulous exanthema ad nates and on the legs. Rhinitis. Enlarged spleen. Spirochetæ +. First injection July 6, 0.04 g. On July 15th child was discharged from the hospital with only a trace of the exanthema and in a much better general condition.

4. Child aged four weeks. Breast fed. An extensive maculopapulous exanthema, and on the hands and feet diffuse syphilides with decubitus. Rhinitis. Spirochetæ +. Wassermann +. On August 19th, injection 0.016 g. Mother (Wassermann +) was injected on September 6, 0.4 g. This was followed by a fading of the exanthema, rapid healing of the ulcerated patches and a marked improvement in general condition. Spirochetæ —. On May 10th fresh papules appeared on the knee which, after injecting the mother, faded away. Child died later on, after a severe diarrhea. Autopsy—Diffuse purulent peritonitis (streptococci found). Large liver. Bronchitis. Atelectasis.

5. Child aged five months. Breast fed. Papulous eruption on face, neck, axillæ and legs. Rhinitis. Saddle nose. Mother is 22 years old and shows no signs of lues at this time. On September 10th mother was injected with 0.5. On September 24th child was brought to clinic much improved. Papules fading away.

6. Child aged three months. Artificially fed. For two weeks a papulosquamous eruption on the face, buttocks and extremities. Rhinitis and great enlargement of the liver and spleen. Spirochetæ +. Wassermann +. Injection, August 19th, 0.022 g. This was followed by a much improved general condition. Liver and spleen much smaller. Eruption fading. Spirochetæ —. On August 26th another injection of 0.024 g. was given. Spirochetæ —. In next few days, by August 29th, eruption completely disappeared.

A change for the better follows the injections so promptly that every unprejudiced observer must get the impression of a specific influence. The rhinitis seems to resist the treatment more than any of the other symptoms. Particularly marked and rapid improvement was noticed in cases with syphilitic bone changes.

In conclusion, the author states that the tolerance shown by infants for the injections would justify a gradual increase in the dose, and perhaps then Ehrlich's ideal of a therapia sterilisans magna with a single injection will be realized.

Theisen.

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BOOK REVIEW.

Handbuch der Speziellen Chirurgie des Ohres und der Oberen Luftwege.

Edited by KATZ, PREYSING and BLUMENFELD. Published by Curt Kabitzsch, in Würzburg. Price, complete in four large volumes, 120 marks ($30.00).

Three parts of this new system of the surgery of the ear, nose and throat have already been delivered, and the importance and size of the work demand a preliminary review. This magnificent contribution to the anatomy and surgery of the ear and upper air passages is under the leadership of Katz of Berlin, Preysing of Cologne and Blumenfeld of Wiesbaden. The parts are being delivered as soon as published and contain about 50 pages each. When completed the work will consist of four volumes of over 500 pages each.

The central idea of the work is to give to specialists an absolutely complete review of all surgical procedures now included within our broadened surgical field, and at the same time to put in their hands an anatomic text book, the like of which has never been attempted under one cover.

Certainly the first three numbers are the finest examples of text-book making that have ever come into the present reviewer's hands. The first chapter on the topographic anatomy of the head, including the ear and nose, is by the famous anatomist, Sobotta, of Würzburg. The plates are all in colors, many of them new, and a large number of them taken from the last edition of his anatomy. The text is very brief and clear, the pictures explaining themselves.

The second chapter on the anatomy of the accessory cavities, by Onodi, has certainly been placed in the hands of the man who has done more original work along these lines than anyone in Europe. It is very complete, and he has selected for the article the cream of the numerous plates which he has so freely published during the last few years.

The work has been undertaken at enormous expense and has been in preparation for about four years. Each part will be assigned to someone especially well known in that particular line, and when finished will be the leading text book for many years to come. The publishers, who have had large experience in special publications, declare this to be the most important work which has yet come from their presses.

Horn.